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THE N. E. L. A. CONVENTION.

The thirty-fifth annual convention of the National Electric Light Association, just concluded at Seattle, throws into prominent relief the important achievements in the central-station industry during the year that has just rolled by. One of the most healthful signs of progress was the marked increase in interest shown in those questions pertaining to public policy and the mutual relations which ought to exist among the public utility corporation, the body of employees and the public served. Our national unrest, both social and industrial, did not pass unnoticed, and the observations of responsible and experienced men in the industry on lessening the public discontent should be most carefully heeded.

The keynote of the convention, in a commercial sense, was unmistakably the stimulation of electric energy sales through the promotion of new devices and appliances for domestic and industrial use, and the searching out of new and economical applications for electric energy in both urban and rural communities. The work of the commercial section aroused the keenest interest, and there is no doubt that the central-station industry is now developing fastest on the salesmanship side, thus balancing the many and rapid advances on the more purely technical side of the art. This is a welcome tendency, because it not only stimulates the whole art, but as well forecasts greater financial stability of the industry and tends to uphold business confidence the country over. Rate research plays a fundamental part, and the committee, having before it the example of what can be done with scientific schedules in one of our largest cities, has obviously much valuable work to perform in spreading sound doctrines and following them up with unassailable conclusions from experience. The committee's appreciation of the need for constant study of the question is well shown by the perfection of an organization for continuous work.

Keen interest displayed itself also in the applications of electric energy to irrigation and farmwork, with the splendid example of what has already been done in the Western country so close at hand for observation and study. The report of the street-lighting committee presented an admirable review of the rapidly changing practice in its particular field and clearly pointed out to the operating companies that they will secure the best results by uniformly adopting the policy of owning street-lighting systems, as contrasted with private or possibly public ownership. Technical progress, relating particularly to operating practice, was most ably covered by such reports as those presented by the committees on prime movers, on electrical apparatus for generating and substations, and on underground construction. The tendencies in the way of changes

in design or construction, and the character of urgent problems needing solution, were set forth in substantially clear form. Electrolysis of underground structures, in particular, was taken up very thoroughly, and the work of the committee can well be continued to discuss concrete examples of prevention or relief at much greater length.

The approaching knell of the carbon-filament lamp, the rapid substitution for the former of the graphitized-filament lamp for general service, and the prediction that the tungsten lamp will be the standard of the not remote future, were the salient features brought out in the discussion of the lamp situation. Much credit is reflected on the committee on grounding secondary circuits for the successful outcome of several years of arduous work in bringing together so many diverse interests and evolving harmonious assent to the proposition of mandatory grounding at potentials of 150 volts or less and permissive grounding at higher pressures. Much remains to be done, however, in respect to the details of installation and particularly in finding the cheapest satisfactory earth connection. The meterman's handbook is a worthy accomplishment, in which the meter committee may take a just pride, and it stands forth as one of the salient features of the convention. This, in connection with the exhibit of meters under the committee's auspices, made up an important and interesting record of the present state of development of metering devices. Conservation of natural resources and the obstructive features in the policies of the federal administration in reference to the development of water-power sites in the public domain were perhaps the most prominent topics considered in the meetings of the hydroelectric and transmission section. The address delivered by Mr. R. A. Ballinger, ex-Secretary of the Interior, emphasized certain defects in the existing policy, but set forth in detail no well-thought-out, constructive plan for development under reasonable regulations.

Considering its broad humanitarian service and its enduring value, nothing done at the convention transcends the work of the resuscitation commission. The more one reflects upon this accomplishment, the keener becomes the sense of the obligation under which the commission has placed the entire industry. It would be improper, in passing, not to refer to the accounting sessions, in which the interest appears to increase and which play an important rôle in balancing the activities of the association. Lastly, the adoption of constitutional amendments broadening the requirements for Class D members will increase the association's usefulness and influence and also assist in further raising the membership above the 12,000 mark. How much remains to be done in reference to Class A membership, however, is shown by the fact that slightly less than one-fifth of all the central stations in the country are in the association.

Now that the convention is over there is only one opinion in relation to it by those who attended its sessions, and that is that the 1912 meeting in Seattle has been an unqualified success in every particular. As was expected, the attendance was not so large as at some of the recent conventions in the eastern part of the country, but in quality of attendance nothing was lacking. A large representation of the leading men in the industry was present, and the proportion of attendance at sessions to total registered attendance was much greater than at some conventions where the total number registered has been considerably larger. It was a working convention. Twenty sessions were held during the three days of June 11, 12 and 13, and it is safe to say that every delegate was busy morning, noon and night with the actual work of the convention. The advantages of the Seattle convention will be twofold—to the association itself by reason of the direct work accomplished and also owing to contact with a type of Americanism and bold electrical accomplishment which it is good to know about, and also to the territory visited, which should receive some benefit from the demonstration of the solidarity of the electrical art and industry. The association has proved that it is a national society in fact as well as in name; the problems encountered by the electrical public utility companies in New York, New Orleans and Seattle, for example, are fundamentally the same.

THE RESOURCES OF A SINGLE RIVER.

The description of the plants of the Washington Water Power Company elsewhere in our columns gives a splendid example of the utilization of the hydraulic resources of a single stream. The Spokane River was one of the earliest utilized for incandescent lighting. It is, if we remember correctly, more than a score of years since the stream was first employed for supplying energy to a low-tension distribution system in the then rapidly growing city of Spokane. The plant, in practically its original situation but greatly changed in equipment, is still in operation and to its resources has already been added the output of two more stations aggregating more than 30,000 kw. From a little three-wire system in the center of Spokane there has grown up a widespread network with more than 500 miles of 60,000-volt transmission. Still another station with an output of more than 60,000 kw is now being installed as an added evidence of the importance of the commercial development of the system. Besides all these stations there is a steam auxiliary for about 14,000 kw in equipment in Spokane itself.

All the hydraulic plants are on the Spokane River, one of them to the east of the city at the foot of Cœur d'Alène Lake which serves as a great storage reservoir, a second at Little Falls about an equal distance to the west of the city, while the third, which is shortly to be enlarged by taking a larger head of water, is, as already mentioned, in the city itself. The great development at Long Lake, involving a dam nearly 200 ft. in height and the formation of a storage lake 23 miles long, is to the west of the city and somewhat nearer than the Little Falls plant which is already in operation. This plant is notable for the huge waterwheels which are now being built for it, each of the four being rated at 22,500 hp. The completed plant will thus have four hydroelectric stations along the same stream, but including in their hydraulic resources two big independent storage basins, one above all the plants, the second

above the two lower and larger plants. The dam at the Long Lake development is not only remarkable on account of its unusual height but in being a spillway dam having in times of flood nearly 20 ft. of water over its crest. A feature of much interest in the system is the auxiliary station. This does not have, even under present conditions, to be put in use often or for long periods, but the situation with respect to fuel cost is such that it was found desirable to design the station in a fashion differing widely from the typical auxiliary plant. Slack of not very high grade costs in Spokane $4.23 a ton at present, and it is therefore not desirable to build an auxiliary plant regardless of efficiency, as is sometimes the case where a cheap fuel supply is available.

The relay station in this case is a thoroughly modern steam-turbine plant with water-tube boilers and superheaters and with all the devices for economy to be found in a typical urban station. There are only two turbine units, which is about the only point of design which would mark the station as auxiliary to hydraulic plants. When put in operation it can carry the load with a high degree of economy for whatever period is necessary, and while not often used has proved extremely valuable in a few emergencies. The extent to which this group of plants has grown and the amount of business which is done form a splendid monument to the prosperity of that particular territory, continued now for many years, and to the enterprise which has built up so notable a network from the little Edison bi-polar equipment that was spinning busily over the waterwheels twenty years ago.

PUBLIC POLICY FOR CENTRAL STATIONS.

The report of the public policy committee of the National Electric Light Association is a document which we wish could be read carefully and thoughtfully by every member of every city government in the United States. Its perusal would show, perhaps better than any other evidence, the genuine public-spirited attitude to be found among progressive central-station men. One does not have to run back very far in memory to come upon a period of constant friction and irritation between most city governments and the lighting companies which were endeavoring to serve them. This unpleasant condition had a very complicated history and many factors entered into it. One must recall the sinister fact that the relations between the public service corporations and the city governments were too often mutually predatory or at best suggestive of an old-fashioned horse trade. It is not too much to say that at the present time the feeling of distrust and irritation has almost disappeared. There are differences, to be sure, such as must always exist between people who are doing business together, but year by year and more and more the tendency is to try for a square deal on both sides. This spirit is admirably shown in the report of the very representative and able public policy committee. The one predominating sentiment which runs through it all is a fine sense of responsibility on the part of the public service corporation for its public, its employees and its service. Such corporations realize fully the changes which are going on in the body politic and the great importance of anticipating their result.

There is a feeling of unrest throughout the industrial world, as the committee wisely says, and the old order is undergoing change. There is an awakening of public conscience, the uprising of a new democracy with new ideals of government. When these facts are fully realized by public service corporations, as they have been by the representatives who form the public policy committee, it is easy to see the road along which public service corporations must march. The tendency of the present governmental movement is to give them a free hand and a freedom from unreasonable monopoly, exacting in return absolute fair play, and the central-station industry is disposed to meet the people fully half way in these particulars.

Very interesting, too, are the reports on welfare work and co-operation with employees in the various forms in which such work has been undertaken. Ten years ago it would have been difficult to inaugurate successfully much work of this kind. Public utilities had not then passed out of the period when exploitation dwarfed operation. Central-station men now look to their properties as things, not of next month or next year, but of the next generation—permanent properties, forming an integral part of the common interests with which they have grown into their commanding strength. This outlook of permanency gives impulse to welfare and co-operative work of the most efficient character. Such work without corporate stability is utterly futile. It is most striking and encouraging, too, to note the attitude of these great corporations toward the idea of a minimum wage, proportioned to insure a decent living to the employee who attends to his business and does his work. This attitude of itself means stability in the future and is an encouragement to every community touched by it. It is but another fruit of the spirit of responsibility, of fellowship in the community, which is the dominant note of the whole committee report. So long as this spirit is maintained we do not expect to hear very much of municipal plants. When municipalities are able to select their men as carefully and keep them under as close and friendly discipline as does an enlightened corporation, without fear of interference from ward politics, then municipal lighting may be looked at from the standpoint of its economic merits. Yet there are many cheerful theorists who feel that municipal lighting has an immediate future; for their enlightenment we are glad to see that the public policy committee is making, without exaggeration or bias, an analysis of the actual facts disclosed by the various experiments in municipal ownership which have been tried. The list is a long one, as yet but imperfectly studied. This method of attacking the situation is practically certain to appeal to all persons of well-balanced judgment, and it avoids the danger of the public reaction which might result from a one-sided campaign admittedly telling the truth, but not the whole truth. The summation of the facts may not be cheerful reading for a lover of good government, but it will at least prove of value beyond dispute. So long as the present broad spirit holds dominance in central-station operation we have little fear that many municipalities will, in view of the experience of others, be tempted into the dangerous field of public ownership.

CORONA IN HIGH-TENSION LINES.

Among the various interesting papers presented at the recent National Electric Light Association convention at Seattle was one on "Corona," by Mr. G. Faccioli, giving some of the latest information concerning air-disruption losses on high-tension lines. The high-water mark of transmission-line voltage stands to-day at 140 kilovolts, as measured between wires at the generating end of the line. This corresponds to about 200 kilovolts between lines at the maximum of each cycle. Incidentally, the no-load emf between lines at the distant end of the system rises to 165 kilovolts, or to about 232 kilovolts maximum in each cycle, on the basis of sinusoidal waves. Consequently, the peak voltages in use to-day are not far from the quarter-million mark.

Voltages such as the above constitute, in effect, a return toward the patriarchal conditions of electrical science, long before electrical industry existed. The frictional machines, with their rotating glass cylinders of 1-watt or 2-watt power, might, at their best performance, give voltages such as transmission lines now carry. The knobs, spheres and rods of the old static apparatus, which have been allowed to grow dusty on the shelves of our museums, are coming once more into vogue among electrical men. The busbars of a high-tension station begin to look like the "prime conductors" of the old frictional and influence machines. The industry had to climb down from the many kilovolts of the frictional machine to the volt of the voltaic cell before it could restore the conditions of the pioneer electricians.

It was well known to Franklin and the electricians of his day that a metallic point, maintained at a high electric potential, threw off a jet of electrified air, accompanied by a bluish luminous glow visible in a darkened room. This "electric wind," as the phenomenon came to be named, was a particular form of what we now call corona. In those days the electric-wind phenomenon was utilized in a pin-wheel toy for producing rapid rotation. It remains to be seen whether any utilization of corona effects can be made under modern conditions. Thus far corona has shown itself a pure and unmitigated nuisance, but possibly the old pin-wheel rotating by corona, or fly-power corona motor, could be made of some use to show at a distance when a very high-tension busbar was alive.

The paper recites some instructive experiments which show that corona is liable to occur wherever geometrical conditions determine a rapid local gradient of potential in the air. Among other remarkable observations, it instances the fact that when a newly erected transmission line is first brought up to full high voltage the initial corona loss, for the first half hour, may greatly exceed the final corona loss in steady operation, apparently because particles of dust and dirt, initially adhering to the surfaces of the wires, set up steep little gradients of potential in their vicinity, and so precipitate local corona. The electric convection or windage set up by the corona soon dislodges many of these loose particles of dirt. This cleaning of a long-distance transmission wire by electric wind and brush discharge is a novelty that comes as a valuable addition to the powers of a transmission engineer, but is hardly likely to come into competition with the household vacuum cleaner. It certainly uses, however, a brush so long-handled as to sweep a wire clean many, many miles from the point of supply.

OPERATION OF PLUNGER ELECTROMAGNETS.

The article by Mr. Charles R. Underhill which appears this week on the operation of plunger electromagnets draws attention to some important and frequently neglected conditions in the literature of this very practical branch of applied elcctromagnetics. It calls attention to the fact that the ordinary Maxwellian law of magnetic surface intensity of attraction $B^2/8\pi$ dynes per sq. cm is only strictly applicable when the opposed magnetized cores carry their coils with them; so that in separating the opposing cores the magnetizing coils are also separated. When, however, as commonly occurs in practice, the magnetizing coil is in one piece, and only the plunger moves to and fro, then it is possible to introduce serious errors by applying the ordinary Maxwell formula. If the magnetizing force H, in gilberts per cm, is comparatively small, and the iron plunger unsaturated, so that the B induced structurally in the plunger is large compared with the H due to the magnetizing coil, then the error becomes small, and often insignificant. On the contrary, when the plunger is nearly saturated and the H due to the ampere-turns becomes large by comparison with the structural B, then a large error may be made. The theory of the matter was propounded accurately by Maxwell in his original paper on the subject. It is also given in full detail by Ewing in his textbook on "Magnetic Induction in Iron and Other Metals," as well as by S. P. Thompson's papers; so that the doctrine laid down in Mr. Underhill's article is in line with textbook authority. Nevertheless, the facts concerning the matter are often forgotten or imperfectly expressed; so that the article does good service in bringing their practical importance into notice, along with experimental observations in their support.

The simplest way of conceiving the conditions of the electromagnetic circuit is, perhaps, to separate completely, in the mind, the magnetic flux density due to the exciting ampere-turns from that due to the structural ampere-turns in the substance of the iron. The flux density due to the excitation may be regarded as being entirely independent of, and unchanged by, the iron immersed in it. But the iron becomes the seat of an evoked structural mmf which adds its own independent flux and flux density to that already existing. The total flux density observed at any point of the magnetic system is then the sum of the two. When the iron is unsaturated, and the permeability is large, the flux density due to the mmf inside the substance of the iron so far overshadows the excitating flux density that the latter may not be worth considering. At powerful magnetizations, however, and near saturation, the flux density of excitation may greatly exceed the structural flux density, and the two, although associated together, have to be thought of separately. Their mutual attractive forces are distinct. Some of the formulas given in the article will be serviceable to designers of plunger traction magnets.

When the magnetic intensity H is moderate and the flux density in the iron is not excessive, the well-known formulas apply satisfactorily. When H becomes large and saturation is approached, the modified formulas given in the article are applicable. When, however, the conditions include both powerful magnetization and much magnetic leakage, then, as the article points out, the complexity of the case places it beyond present exact calculation.

THE STREET-LIGHTING SITUATION.

The report of the street-lighting committee of the National Electric Light Association must be regarded as a study rather than a definite pronouncement. This is perhaps inevitable, considering the complexity of the subject and its present unsettled condition. Certainly the present state of street lighting demands cautious treatment on the part of central-station organizations, and the present report is above all things replete with cautiousness. It is plain to see, however, that the pressure of events is working in the right direction, and the committee report indicates that the sounder judgment of those in the business tends toward an honest rating of illuminants on the basis of flux of light. This is a long step forward, and we wish it had been taken squarely and unequivocally. An evaluation of street lamps based on luminous flux is certainly much nearer in the present state of affairs to a just basis than the altogether absurd and evasive rating of the so-called X values of 1908. We expressed our feelings somewhat fervently at that time and have seen no reason to change our views in the interim. The fact is that there has been an unfortunate tendency to introduce ratings intended to produce certain definite commercial results which could be foreseen by anybody with the slightest knowledge of the art. The present committee report is at least free from this evident axe-grinding and will lead the way, perhaps by another convention, to the really scientific study of the subject which the present committee from lack of time was unable to undertake.

The broad facts which lie back of all these struggles to obtain a basis of comparison among street lamps are as follows: In the early days of the art the only street lamps in use on any large scale were of the series direct-current open-arc type. When carefully run with high-grade carbon electrodes they were and are good illuminants. But they require electrodes not to be obtained cheaply in this country, thanks to the tariff, the high cost of intelligent labor and the need for daily trimming. When twelve or fourteen years ago series inclosed-arc lamps appeared in the wake of the constant-potential inclosed-arc lamps of the previous half decade, they were welcomed. In point of steadiness they were a great improvement over the open-arc lamps as ordinarily run, and the long life of the electrodes made them cheap to operate. The direct-current inclosed lamp was, by and large, a pretty good equivalent for the open-arc lamp, although it unquestionably gave less light. The alternating-current arc lamps had not, as various judicial decisions and many tests show, anything like the equivalent in light-giving power of the old so-called 2000-cp arc lamp. When worked near the limit of endurance of the inner globes, say at 7.5 amp, the alternating-current arc lamps were passable equivalents of their predecessors. At 6.5 amp or thereabouts they were distinctly inferior, giving actually at a favorable angle below the horizontal somewhere from 150 cp to 200 cp. These small arc lamps were, however, so cheap to operate that there was a persistent and carefully directed effort, particularly among the small central stations, toward substituting these for the much more powerful open-arc lamps. This was sometimes done openly with the arrangement of a new contract, and sometimes, without creating an issue, under the terms of an old contract.

Most of the legal actions cited in the committee report before us have been based on the informal substitution of the feeble 6.6-amp alternating-current arc lamp for the 9.6-amp open-arc lamp. From the standpoint of service, inordinate and unjustifiable claims were made for the inclosed-arc lamp, which, from the standpoint of light flux, could hardly be taken seriously. It is perfectly true, as the present committee has said and as many have said before it, that there are physical and psychological considerations in street lighting beyond the mere quantity of light furnished. Doubtless a candle-power from a well-operated inclosed-arc lamp is more serviceable, on the whole, than a candle-power from a badly operated open-arc lamp, and it is easy to see why cities have assented to the substitution, particularly when accompanied, as was common, by a material reduction in price. It must be admitted, however, by everyone who knows the technique of arc-lamp practice that a direct-current open 9.5-amp arc lamp operated as such lamps are habitually operated abroad, with high-grade carbon electrodes and with diffusing globes, is in an entirely different class from any inclosed carbon arc lamp in use in this country. A comparison made between such a lamp and even the 7.5-amp alternating-current arc lamp would leave the latter forever out of the reckoning.

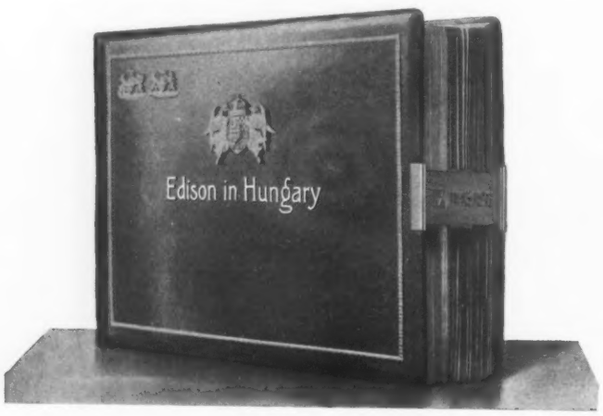
The reports of the National Electric Light Association committees of 1907 and 1908 represented the last despairing efforts to find some method of rating which would make two and two seem five and evade the deadly directness of a light-flux comparison; but the art has changed and the National Electric Light Association is progressively taking broader views of the problems before it. The coming of lamps combining high power and long electrode life and the introduction of the large metallic-filament lamps have changed the situation in every respect for the better. If the old open-arc lamp is nearly obsolete, the inclosed carbon arc lamp is obsolescent, as the committee report frankly states. There is no longer any object in trying to focus attention on side issues. One cannot afford, as the report before us points out, wholly to ignore the distribution curve of lamps nor their physical and physiological characteristics, but in the last resort, for the kind of street lighting that is now undertaken and with the admirable lamps now available, light flux is the chief factor in the value of a street illuminant. We might as well come to this rating first as last, giving the other considerations due value for what they are worth, and we hope that the present report will later lead to exactly this step and incidentally to an official rating of the great and admirable group of modern street illuminants based unequivocally upon lumens.

OLDFIELD PATENT BILL.

According to the latest reports, the sub-committee of the House committee on patents has practically determined to alter the Oldfield bill (H. R. 23,417) or to substitute a new bill covering only the provisions of Sections 17 and 32 of the Oldfield bill, relating to compulsory license and working. It is stated that the revised bill will probably stipulate that working shall be compulsory only in the case of persons who have purchased an invention with the express purpose of withdrawing it from use. The determination of the purchaser's intent will be subject to decision by the courts, under certain carefully specified conditions. The report further states that the terms under which a license must be granted will be somewhat dissimilar from the corresponding provisions in the original bill. In this modified form it is hoped to secure favorable action from the committee as a whole and possibly to enact a bill at this session of the House. The remainder of the original bill will probably be laid aside until a later session. It is further reported that this modified program is a direct outcome of the intense opposition which has been manifested against the original bill at the extended hearings before the sub-committee. One of the most active and vigorous campaigns carried on during the present session was conducted by the interests which had resolved, if possible, to defeat the original bill.

AN ECHO FROM EDISON'S VISIT TO HUNGARY.

The royal manner in which Mr. Thomas A. Edison was received and entertained during his visit in Hungary and Moravia was described in our issue dated Oct. 7, 1911. Mr. Edison has just received an elaborately planned album containing not only views of the principal edifices visited but photographs of many of the distinguished persons met and all of the clippings from Hungarian newspapers that



Album Presented to Mr. Thomas A. Edison by Hungarian Friends.

commented on his visit in Hungary. A view of the album is given herewith. It forms an excellent specimen of Hungarian art and workmanship. The leather was expressly chosen in its raw state and tanned and dyed to special order for the album. The large coat-of-arms of the Kingdom of Hungary and also those of the cities of Budapest and Pozsony are samples of artistic chasing and enameling. The raised letters giving the laconic inscription "Edison in Hungary" as well as the bordering ornament and clasp are made of gold bronze.

The presentation of the album to Mr. Edison as well as its arrangement in detail was suggested by Mr. Etienne de Fodor, director general of the Budapest General Electric Company.

BIG CREEK-LOS ANGELES TRANSMISSION SYSTEM.

Plans for the Pacific Light & Power Corporation's development on Big Creek, Cal., which is now in progress, have advanced so far that the following preliminary outline of the scheme can be given: There will be two power houses about 4 miles apart, each containing two units initially but laid out for six units ultimately. Generators will be of 17,500-kva rating and will be wound for 50 cycles, three-phase, 6600 volts. There will be two 250-volt exciters, each of sufficient size to excite two generators. These exciters will be arranged for both waterwheel and motor drive.

Each power house will contain two banks of three step-up transformers of 5833-kva rating each, which will be connected delta on the low-tension side and star on the high-tension side. These transformers will be of the oil-insulated, water-cooled type. The switching arrangements will include high-tension and low-tension buses with a complete set of electrically operated oil switches, permitting the generators and lines to be operated either in multiple or separately.

There will be two transmission lines each 275 miles long, each carrying a single circuit of three steel-cored aluminum cables. These cables will be made up of a 78,500-circ. mil, seven-strand steel center, covered with 605,500 circ. mils of aluminum in fifty-four strands of the same size, making a cable of 684,000 circ. mils total section in sixty-one strands. These cables will be nearly an inch in diameter and they will be operated well below their critical emf at 150,000 volts. The insulators will be of the suspension type. At about the middle point of the line there is to be a switching station with oil switches, permitting either half of either line to be placed in service.

The substation in Los Angeles will contain four banks of three 4500-kva step-down transformers, having four-coil secondaries which may be connected in multiple for 18,000 volts and in series for 72,000 volts. These transformers also will be of the oil-insulated, water-cooled type. The substation will be provided with busbars for 150,000, 72,000 and 18,000 volts with electrically operated oil switches for control of the transformers and feeder circuits. The high-tension transmission system will be protected from short-circuits on the outgoing distributing feeders by inverse-time-limit relays, which will be installed on each 72,000-volt and 18,000-volt circuit.

The substation will contain two 15,000-kva, 6600-volt synchronous condensers, operated from the 18,000-volt busbars through two banks of three 5000-kva, single-phase transformers. The transmission system will be operated at approximately 150,000 volts constant potential at each end of the line, the voltage being controlled by Tirrill regulators on the generators in the power stations and by the synchronous condensers in the substation. The condensers will assist in the line regulation by giving lagging currents at light loads, counteracting the rise in voltage which would otherwise be produced by the charging current of the line, and leading currents at full load to neutralize the lagging currents from the large induction motor load which is to be expected on the system and which would produce a drop in voltage at full load.

This whole transmission system is to feed energy into the existing lines of the Pacific Light & Power Corporation, to which are already connected a number of smaller water-power plants and a steam relay plant at Redondo, about 18 miles southwest of Los Angeles, containing 40,000 kw of steam-turbine and engine-driven generators.

All the work at Big Creek, including storage basins, flow lines and power houses, has been placed in the hands of the Stone & Webster Engineering Corporation of Boston, as designer and constructor. This firm is also acting in an advisory capacity on the transmission system, the longest straight-away system in the country.

N. E. L. A. CONVENTION NEWS.

The leading features of the N. E. L. A. convention, covering the events up to the opening of the Thursday, June 13, sessions, were covered in the report in our issue of June 15, most of which was communicated by telegraph. Succeeding events of special interest are chronicled below for the benefit of the considerable number who were unable to attend the convention and are desirous of following in detail all which took place. The program for the Thursday session was carried out as prearranged, and in addition there was a special session on irrigation which was arranged at the last moment as a result of the unexpected interest shown in the application of electric energy to the irrigation of arid farm lands in the West. A full account of the formal reports and papers, together with the ensuing discussions, is presented elsewhere in this issue. The total registration was 1473.

CONSTITUTIONAL AMENDMENTS.

In accordance with the recommendations of the committee on constitution and by-laws, of which Mr. F. W. Frueauff, of New York City, was chairman, the association was asked at the third general and executive session to enlarge Class D membership by admitting electricians, electrical or mechanical engineers, manufacturers, publishers, bankers and brokers, or others who are directly or indirectly interested in advancing the use of electricity. The committee also recommended certain changes in the dues of member companies and in the disposition of moneys to geographic sections and to special sections. Provision was also made whereby officers of the association may invite annual subscriptions from Class D members upon some basis which shall seem fair in proportion to the business carried on by these members with the central-station companies. The purpose of the amended section is to permit and encourage subscriptions, and while the committee looked with favor on a plan for dues based upon the volume of business transacted with the central-station industry by Class D members, its recommendation was restricted to the encouragement of subscriptions from those who may care to assist in the association's work. Amendments were also made whereby member companies may assist their Class B and Class E members by arranging for the payment of their dues over a period of months on an instalment plan. There was no discussion on this report, which was adopted as proposed, without change.

COMMITTEE ON MEMORIALS.

Secretary T. C. Martin as a committee of one on memorials presented brief biographical sketches of men who had passed away during the year and who were either actively connected with the work of the association or active in the central-station industry. The twenty-five names reported were as follows: Prof. Henry Taylor Bovey, William Richard Brixey, C. C. Cokefair, Thomas Jefferson Cooolidge, Jr., Daniel D. Dickey, Samuel Morris Dodd, Jacob H. Evans, Lee D. Fisher, N. Wetmore Halsey, Caryl Davis Haskins, Edwin Hawley, William Penn Hazeltine, George W. Hebard, Daniel G. Hemingray, James McCormack, John C. McGensey, B. G. McNabb, Robert Mather, Edgar Wood Mix, George B. Moffatt, Hinsdill Parsons, Otis E. Putnam, Frank Ridlon, Alden M. Young and Charles I. Young.

AWARD OF DOHERTY MEDAL.

At the third general session Past-president W. W. Freeman repeated the announcement made at the company sections meeting that Mr. C. N. Duffy, of Milwaukee, Wis., had been awarded the Doherty Medal, and that honorable mention had been conferred upon Messrs. C. J. Russell, of Philadelphia, Pa., and Egbert Douglass, of Milwaukee, Wis. Mr. H. L. Doherty again exhibited his desire to stimulate competition in the presentation of meritorious papers by announcing that the medal is offered for another year, and at the same time he announced the offer of two new medals, one of silver and one of bronze, or in lieu thereof prizes of $50 and $25 respectively, on condition that the silver medal or the fifty-dollar prize be known as the Harriet Billings Medal, in honor of the assistant secretary and treasurer of the association. During the same session Past-president W. C. L. Eglin presented a motion to send a congratulatory telegram to Miss Billings at Arlington, Vt., which was seconded by Past-presidents Freeman and Doherty. The message read as follows: "At the executive session, upon motion of W. C. L. Eglin, seconded by Henry L. Doherty and W. W. Freeman, the following resolution was unanimously adopted: 'The thirty-fifth annual convention extends its most hearty greetings for your continued health and happiness and kindest expressions of appreciation for all your efforts on behalf of the association.'" This was signed by Mr. John F. Gilchrist, president.

MEETING OF CLASS D MEMBERS.

The regular annual meeting of Class D members was held on Thursday noon with some twenty members in attendance, and Mr. J. C. McQuiston, of East Pittsburgh, Pa., chairman, made a brief address. He touched on the activities of the exhibition committee and compared the present display of some forty or more exhibits with the comparatively humble exhibit held six years ago in Denver, when there were only six displays in five hotel rooms. The recommendation was presented for broadening the scope of the activities of the Class D section, which up to this time have been confined to regular exhibits. This recommendation was referred to the exhibition committee.

PRESIDENT-ELECT FRANK M. TAIT.

The report of the committee on nominations recommended the election of Messrs. J. W. Perry and F. N. Jewett to fill one-year terms of office on the exhibition committee, and of Messrs. F. H. Gale, S. E. Doane and J. F. Gilchrist for three years. The secretary-treasurer stated that the committee's receipts were such as to enable the section to meet all expenses. On Thursday evening at 6 o'clock the main exhibition in the Armory was thrown open to the public of Seattle and a large attendance marked the rapidly increasing interest in central-station service and electrical energy for household and commercial uses.

FINAL EXECUTIVE SESSION.

At the third general and executive session President Gilchrist's report was ordered printed, and his recommendations relating to the growth of membership, the appointment of a traveling representative, an increase in the number of vice-presidents and the increase in the dues of member companies were all indorsed. Minor changes

recommended in the report of the overhead-line construction committee as submitted by the technical section were approved. Formal approval was also voted on the report of the committee on grounding secondary circuits. The secretary was instructed to telegraph the greetings of the association to President A. A. Dion, of the Canadian Electrical Association, conveying wishes for a successful meeting at Ottawa this week. By a unanimous vote, Mr. A. C. Dunham, former president of the Hartford Electric Light Company, Hartford, Conn., was elected an honorary member of the association.

COMMITTEE ON RESOLUTIONS.

Mr. Arthur Williams, chairman of the committee on resolutions, submitted a long list of committees, companies, cities, individuals, etc., to whom the association was under obligations for the many courtesies extended. A motion was passed to extend the thanks of the association to the numerous committees of the association presenting reports at the convention and taking part in the arrangements; to the various lighting companies, boards of trade, railroad companies and the Puget Sound Traction, Light & Power Company, which had entertained the delegates on various occasions, and to the technical press, especially to the McGraw Publishing Company for its work on the *Convention Daily*, and to the local press for the publicity given.

ELECTION OF OFFICERS.

On the recommendation of the nominating committee, the following members were elected to office for the ensuing year: For president, Mr. Frank M. Tait, of Dayton, Ohio; for first vice-president, Mr. J. B. McCall, of Philadelphia, Pa.; for second vice-president, Mr. H. H. Scott, of New York City; for treasurer, Mr. W. W. Freeman, of Brooklyn, N. Y.; for members of the executive committee for three years, Messrs. J. A. Britton, of San Francisco, Cal.; C. E. Groesbeck, of San Diego, Cal., and C. A. Stone, of Boston, Mass.; for executive committee member for one year, filling Mr. Scott's unexpired term, Mr. R. S. Orr, of Pittsburgh, Pa. Upon being formally escorted to the chair of his new office President-elect Tait made a happy speech of acceptance, after which the convention was formally adjourned. A sketch of Mr. Tait's career is given herewith.

THE PRESIDENT-ELECT.

Mr. Frank Morrison Tait, the newly elected president of the National Electric Light Association, has served both as first and second vice-president and was the last secretary and treasurer of the National Electric Light Association to be chosen to serve before Mr. T. C. Martin was appointed as permanent secretary. During the past six years he has been a member of the committee on state and company branches, the committee on co-operative electrical development and the committee on section organization, and he is now a member of the lamp committee of the National Electric Light Association. He has presented papers before the Electric Vehicle Association of America on the electric vehicle and has served as a member, and later as chairman, of the electric vehicle committee of the Association of Edison Illuminating Companies. He is also a member of the American Institute of Electrical Engineers, the Illuminating Engineering Society and the American Gas Institute.

Mr. Tait was born in Catasauqua, Lehigh County, Pennsylvania, in 1874. After graduating from a high school in that neighborhood he obtained employment in the electric wiring and telegraph business. In 1894, at the age of twenty, he became manager of the Catasauqua Electric Light & Power Company, and he was later made manager of the Catasauqua Gas & Electric Company, which was formed by combining the former company with the local gas company. He subsequently had charge of electric lighting plants at Somerville, N. J., and New London, Conn. In 1905 Mr. Tait became manager of the Dayton (Ohio) Electric Light Company, with which he has been associated continuously since that time. At the present time he is president and manager of the Dayton Lighting Company, which is a consolidation of the Dayton Electric Light Company and the Montgomery County Electric Light Company. He is vice-president of the Xenia (Ohio) Gas & Electric Company.

ELECTION OF SECTION OFFICERS.

The following nominations for officers of the hydroelectric and power transmission section for the ensuing year were presented by Mr. H. H. Scott: For chairman, Mr. W. N. Ryerson, of Duluth, Minn.; for first vice-chairman, Mr. D. B. Rushmore, of Schenectady, N. Y.; for second vice-chairman, Mr. P. M. Lincoln, of East Pittsburgh, Pa.; for secretary, Mr. Farley Osgood, of Newark, N. J. Nominations for the executive committee were also submitted as follows: Western members, Messrs. J. A. Lighthipe, Los Angeles, Cal.; H. A. Lardner, San Francisco, Cal.; D. L. Huntington, Spokane, Wash.; P. T. Hanscom, San Francisco, Cal. Eastern members, Messrs. H. T. Porter, New York City; J. F. Vaughan, Boston, Mass.; P. G. Gossler, New York City; F. B. H. Paine, Buffalo, N. Y.; W. R. Thompson, Chicago, Ill.; R. D. Mershon, New York City.

Chairman J. F. Becker, of New York City, presented for the nominating committee the following names of those recommended to serve for one year as officers of the commercial section: For chairman, Mr. E. W. Lloyd, Chicago, Ill.; for vice-chairman, Mr. T. I. Jones, Brooklyn, N. Y.; for executive committee, Messrs. E. L. Callahan, Chicago; J. R. Crouse, Cleveland, Ohio; J. F. Becker, New York; F. B. Rae, Jr., New York; F. H. Gale, Schenectady, N. Y.; M. C. Rypinski, Pittsburgh, Pa.; George Williams, New York; P. S. Dodd, New York; J. C. McQuiston, Pittsburgh, Pa.; Stanley Walton, San Francisco; C. N. Littlefield, New York City; H. J. Gille, Minneapolis, Minn.; Douglass Burnett, Baltimore, Md., and W. E. Robinson, a member of the National Jobbers' Association.

REJUVENATION OF THE SONS OF JOVE.

On Thursday evening, June 14, a rejuvenation of the Sons of Jove was held in the principal meeting room in the Armory and a class of eighty-eight members was duly initiated into the mysteries of the order. Following the formal exercises the members were addressed by several prominent Jovians, including Messrs. John F. Gilchrist, Frank M. Tait and J. Robert Crouse. Thereafter a buffet luncheon was served and an excellent vaudeville program closed a most successful and enjoyable evening.

EXCURSION TO SNOQUALMIE FALLS AND WHITE RIVER.

On Friday, June 14, the attending delegates and their families were invited by the Puget Sound Traction, Light & Power Company to join an excursion to the celebrated Snoqualmie Falls, where the company has two novel and interesting hydroelectric developments, returning to Seattle by way of the recent White River development, which also possesses unique features. A special train of eight cars left Seattle at 8:30 a. m., carrying a large party who thoroughly enjoyed the occasion. After viewing the Snoqualmie development the party returned to the train and was served with a luncheon while en route to Deiringer, the station on the White River development. The party arrived in Seattle at 7 p. m. after a most instructive day's trip.

This occasion marked the last of the features on the convention program and the various members and their parties, except those traveling by the "Red Special," separated and proceeded on their several routes homeward. Many of those who attended took advantage of this unusual opportunity to stop over on their return at one or more points of interest which it was not possible to visit while en route to the convention. Memories of the Seattle convention will linger long in the minds of all who were so fortunate as to participate.

RESUSCITATION FROM ELECTRIC SHOCK.

As a supplement to our National Electric Light Association convention issue, dated June 1, we printed the chart prepared by the commission on resuscitation from electric shock and described in a report submitted by the chairman of the commission, Dr. W. B. Cannon, at the Seattle convention. This report is given below.

PRELIMINARY REPORT OF THE COMMISSION ON RESUSCITATION FROM ELECTRIC SHOCK.

The electric current may kill either by temporarily paralyzing the nervous control of the muscles of respiration or by stopping the regular beat of the heart. When the heart is seriously affected it ceases to contract as a whole, but continues to contract in parts here and there, so that it appears to quiver. It is then said to "fibrillate."

Fig. 1—Position of Shocked Body When Found.

Fig. 2—Removing Obstructions from Mouth of Victim.

In this condition the heart fails to keep the blood circulating and death quickly results. At present no practical procedure has been discovered which will restore the regular beat of the heart in man after it begins fibrillating. The chief hope of resuscitation for the present lies in the proper treatment of the cases of paralyzed respiration, and the immediate necessity in these cases is promptness in applying artificial respiration and continuance of the process until natural breathing returns. In some instances, however, the heart may be merely weakened without being made to fibrillate; then again artificial respiration may be of vital importance, because a greatly weakened heart leads to impairment or total stoppage of respiration, which in turn destroys the last vestige of the heart-beat. In all cases, therefore, an attempt should be made to restore natural breathing. Fortunately artificial respiration can be applied by laymen without the need of complicated apparatus.

The older rules for artificial respiration, which were widely posted in this country, described the Silvester method, a method which directs that the victim of the accident be laid on his back and his chest expanded and compressed by drawing forward his arms and then pushing them back against his ribs. After these rules were published, however, a new method of artificial respiration was devised by Professor E. A. Schaefer, of Edinburgh, called by him the "prone pressure method." It consists in laying the victim on his abdomen and applying pressure rhythmically on the loins and lowest ribs.

Since there was some difference of opinion regarding the relative merits of these two methods of artificial respiration, and since the time seemed ripe for a revision of the old rules and for a possible standardization of new

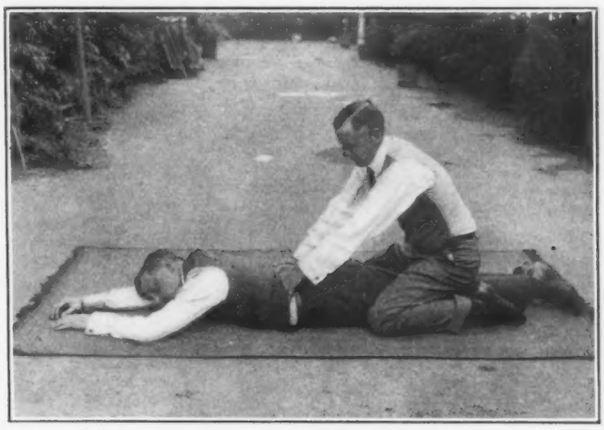


Fig. 3—Inspiration; Pressure Off.

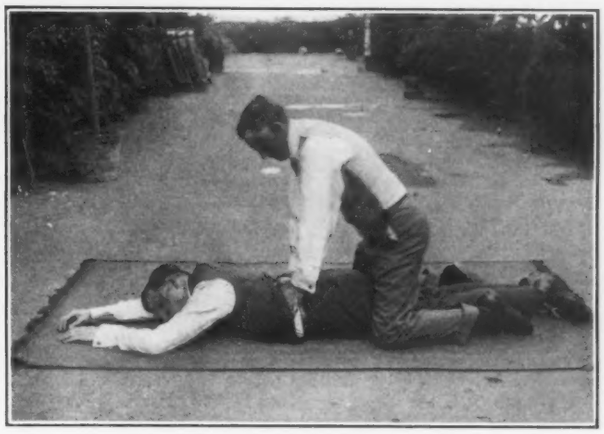


Fig. 4—Expiration; Pressure On.

rules for resuscitation, President Gilchrist of the National Electric Light Association requested that the American Medical Association and the American Institute of Electrical Engineers co-operate with his own association in this undertaking. Through the appointment of representatives of these associations a Commission on Resuscitation from Electric Shock was organized with the following membership: Dr. W. B. Cannon, chairman, professor of physiology, Harvard University; Dr. George W. Crile, professor of surgery, Western Reserve University; Dr. Yandell Henderson, professor of physiology, Yale University, and Dr. S. J. Meltzer, head of the department of physiology and pharmacology in the Rockefeller Institute of Medical Research—the four from the American Medical Association; Dr. E. A. Spitzka, director and professor of general anatomy, Daniel Baugh Institute of Anatomy, Jef-

ferson Medical College, and Mr. W. C. L. Eglin, past-president of the National Electric Light Association—named as representatives of the National Electric Light Association; Dr. A. E. Kennelly, professor of electrical engineering, Harvard University, and Dr. Elihu Thomson, electrician, General Electric Company—nominated by the American Institute of Electrical Engineers. Mr. W. D. Weaver, editor of the *Electrical World,* was elected secretary by the other members of the commission.

The commission was confronted with three problems: (1) The determination of the best method of artificial respiration that can be instantly applied by laymen, and the clear description of that method; (2) a consideration of special mechanical devices for continuing artificial respiration, and the possible invention of a simple and effective arrangement the action of which might be quickly and easily learned; (3) an investigation of the possibilities of restoring the fibrillating heart to its natural pulsation.

The third of these problems has hardly been touched, and possibly, because of the quick disintegration of the brain in the absence of proper blood supply, the solving of the problem may be impracticable.

With regard to the first problem—that of deciding on the best method of artificial respiration—the commission voted unanimously in favor of the Schaefer or prone pressure method. The advantages of this method over the Sylvester are greater simplicity and ease of performance, larger ventilation of the lungs (especially when the subject's arms are drawn forward), absence of trouble from the tongue falling back and blocking the air passages, and little danger of injuring the liver or breaking ribs if proper care is exercised. The accompanying chart,* to be posted in stations, and the pocketbook, to be issued to and carried by linemen, describe the procedure which must be followed in giving artificial respiration by the prone pressure method. The description has been made as concise and clear as possible. A manual procedure, however, is not well learned by reading about it; practice is required for its skilful performance. These rules, therefore, should be carefully practised on a volunteer subject by linemen and all men in central stations, in order that the procedure shall be thoroughly understood.

With reference to mechanical devices for continuing artificial respiration, a sub-committee of the commission has examined two such devices now on the market and will report the conclusions with regard to them later. The desirability of an apparatus which will produce thorough ventilation of the lungs arises from the possibility that even the best method of manual ventilation of the lungs may not be thoroughly satisfactory. The chairman of the sub-committee on mechanical devices, Dr. S. J. Meltzer, has invented a very simple means of securing abundant ventilation of the lungs in such animals as the dog and cat. The apparatus has not yet been tested on human beings, but it probably will be so tested in a short time and may prove an important adjunct to the prone pressure method as described by the commission. Respectfully submitted,

W. B. Cannon, Chairman.

Before reading the report Mr. W. C. L. Eglin, Philadelphia, Pa., reviewed the causes which led to the appointment of the joint committee of the National Electric Light Association, the American Institute of Electrical Engineers and the American Medical Association. At the conclusion Mr. Eglin demonstrated the method of resuscitation on a volunteer, showing the simplicity with which the movements could be carried out. The simplicity of the method is best shown in the accompanying photographs taken at Seattle. On motion of Mr. H. L. Doherty, of New York, the association extended a vote of thanks to the American Medical Association for its work in connection with the other national bodies in this resuscitation movement. He also moved that the work be continued.

*Printed as supplement to the *Electrical World,* June 1, 1912.

TELEPHONE STATISTICS OF THE WORLD.

The American Telephone & Telegraph Company, New York, has recently published some interesting statistics regarding telephones throughout the world. It is estimated that on Jan. 1, 1912, there were in use 12,453,000 telephones, of which the United States had 67.1 per cent, Canada 2.7 per cent, Europe 26 per cent and all other countries the remaining 4.2 per cent. The total length of telephone wires on the same date was 29,566,000 miles, of which the United States had 61.5 per cent, Canada 2.6 per cent, Europe 32 per cent and all other countries 3.9 per cent. Compared with Jan. 1, 1911, this is an increase of 10 per cent in telephones and 9 per cent in length of wires. The increase in length of wire during the period 1901-1912 is 500 per cent, and the increase in telephone stations during the same period is 400 per cent. It is worthy of note that the United States has over one-half the total telephone wire of the world and nearly twice the total mileage of Europe. The world's investment in telephones on Jan. 1, 1912, is placed at $1,729,000,000 and the annual number of telephone conversations at 22,000,000,000, the latter figure being an increase of 8 per cent over 1910. On Jan. 1, 1911, the investment per telephone was $139, and the investment per capita was in the United States $10.27, in Canada $4.76 and in Europe $1.18.

Considering telephones per 100 population, during the period from Jan. 1, 1902, to Jan. 1, 1912, the United States shows an increase from 2.3 to 8.8, Canada from 1.2 to 4.2 and Europe from 0.3 to 0.7. Of the European countries, Sweden and Denmark reach the highest figure of 3.5 per 100 population. Among the American cities, Los Angeles heads the list with twenty-four telephones per 100 population, followed by Chicago with 11, Boston with 9.2, Philadelphia with 8.6 and New York with 8.3. Excepting Stockholm, which has nineteen telephones per 100 population, none of the European cities has reached the development of New York. Neither London, Paris, Vienna nor St. Petersburg has reached a development of 3 telephones per 100 population. Berlin has 5.3, Hamburg 4.7, Christiania 6.9 and Copenhagen 7. In actual number of telephones on Jan. 1, 1911, Berlin, London and Paris, with a combined total of 403,500 telephones, are about even with New York (402,000). The total gross telephone earnings of the world for the year 1909 are placed at $329,000,000, of which the United States earned 67.4 per cent and Europe 27.8 per cent. The average earnings per telephone were in the United States $32.87 and in Europe $35.40.

Attention is called to the progress of long-distance telephone service during the past year. In the United States commercial service was opened between New York and Denver, a distance of 2160 miles, this being now the longest distance over which oral communication is given commercially. In Europe long-distance service has been greatly extended by utilizing the new cables between Great Britain and Belgium and between Dover and Calais, both of which are constructed with Pupin loading coils. The former will enable conversation to be carried on between London and Berlin and the latter between Glasgow, Edinburgh and Aberdeen and Paris.

PUBLIC SERVICE COMMISSION NEWS.

NEW YORK COMMISSION, FIRST DISTRICT.

During the week the Public Service Commission for the First District adopted the Sixty-fifth Street (Brooklyn) and Staten Island route. The resolution provides for the construction of a two-track subway, extending from a point in Brooklyn under Fourth Avenue, at or near Sixty-fifth Street, where a connection can be made with the Fourth

Avenue route as already legalized, and thence extending under Sixty-seventh Street, Owl's Head Park and the Narrows to a point near Arrietta Street in the borough of Richmond, where the route will diverge into two sections, one section running to a point of connection with the North Shore branch of the Staten Island Rapid Transit Railroad and the other running to a point of connection with the South Shore branch of the Staten Island Rapid Transit Railroad.

The commission has received from the secretary the report of gas and electric meters tested during the month of May, 1912. The report showed that 33,319 gas meters and sixty-seven electric meters had been tested. Of the gas meters, 294 were tested on complaint, 6192 were new meters and 26,833 were repaired and removed meters. All of the electric meters were tested on complaint.

MARYLAND COMMISSION.

Plans are being made by the Baltimore Protective Telephone Association for an appeal to the Public Service Commission for a readjustment of telephone charges in the city of Baltimore. A circular letter was sent out last week to all of the members of the association showing some of the rates in other large cities where unlimited service is in vogue. The fight of the association will be concentrated on an effort to have the unlimited service restored in the business section of Baltimore.

Governor Goldsborough last week announced the appointment of Mr. E. Clay Timanus, former Mayor of Baltimore, to succeed Benjamin T. Fendall on the Maryland Public Service Commission. Mr. Fendall's term of office had expired. Mr. Timanus is said to be admirably equipped for the office to which he has been appointed, and his public record is excellent.

OHIO COMMISSION.

On request of City Solicitor O. H. Stewart, of Middleport, Ohio, Attorney General Hogan, of Ohio, has rendered an opinion as to the rights of cities owning public utility plants to undersell privately owned plants, if they find it possible to do so. Mr. Hogan states that municipalities enter the business under the same conditions that private individuals or corporations do and that they have the same rights relative to making rates for service, except that they are forbidden to make rates below the cost of production. All public service companies, he said, enter the business with a full knowledge of existing conditions and they acquire no exclusive field in securing their franchises.

Chairman O. P. Gothlin, of the commission, has been quoted as saying that he has been considering plans whereby the Bell and the independent telephone companies may combine by an exchange of plants and interchange of service in such a manner as to furnish a single service in all the towns and cities of the State. He is reported to feel that the authority of the commission is such that no one will suffer from an undue increase of rates when this is brought about. In this connection it has been stated that the independent companies are not making extensions as rapidly as needed at some points and that the long-distance lines are practically as they were months ago. In reply to a complaint from Dayton, Mr. Frank A. Davis, president of the United States Telephone Company, is quoted as saying that both interests expect to consolidate in all the principal points in the State and that his company does not care to make extensions that would only increase the wreckage when the change finally takes place. The service of the independent companies is not being extended in any part of the State, he said, while the Bell interests are going forward with their improvements and extensions as usual. Mr. Harrison B. McGraw, a Cleveland attorney who has always been opposed to such consolidations, states that they would be just as illegal now as before the public utilities law was enacted.

WISCONSIN COMMISSION.

The commission has refused to grant the city of Waupaca a rehearing in its lighting controversy with the Waupaca Electric Light & Railway Company. In its application for a rehearing, the city objected to the scope of the commission's former investigation on the ground that jurisdiction was assumed in matters not included in the stipulation under which the original case was submitted for arbitration. The original matter concerned the substitution of alternating-current inclosed arcs for open direct-current arcs under the terms of a contract calling for lamps of "2000 nominal candle-power." The commission held that, although the illumination from the inclosed arc as measured by a photometer was materially less than that from the open arc, the advantages which the former possessed in the way of more satisfactory service practically compensated for any deficiency in candle-power, and that if any difference did exist it was too small to be measured by any monetary standard. In its application for a rehearing the city contended that, inasmuch as the inclosed arc now in use is deficient in candle-power, it was entitled to a refund for payments made since the substitution and a corresponding reduction in the future. In denying the application, the commission reiterated its former opinions to the effect that the defendant has substantially fulfilled its contract, although it has not fully complied with the express terms thereof, and no direct or measurable damage has been sustained by the municipality by virtue of the substitution. The commission stated furthermore that even if the city was entitled to a refund it would be more than offset by the sums due the utility company on account of insufficient street-lighting revenues.

The Chippewa Valley Railway, Light & Power Company has been authorized to substitute a revised schedule of rates for the schedule of flat rates now in effect. The revised schedule provides for a primary charge of 12.5 cents per kw-hr. for the first fifty hours' use per month of the active connected load; a secondary charge of 8 cents for the next fifty hours' use, and an excess charge of 4.5 cents. The consumers are classified according to the commission's usual practice. While the revised schedule will result in slight increases in certain cases, it will in general effect a reduction in rates. The schedule of rates for motor service includes a charge of 75 cents per connected horse-power per month, plus a charge of 2 cents per kw-hr. for energy where the installation is over 20 hp; for installations less than 20 hp the energy charge is to be 6 cents per kw-hr. for the first thirty hours' use per month of the maximum demand and 3 cents for all excess.

The commission has authorized the Mineral Point Telephone Company to increase its switching charge from $1.50 per telephone per month to $2 per month. The company applied for a rate of $6, but the investigation showed that the charge as ordered would be sufficient to take care of this branch of the business. The commission also empowered the utility to refuse to furnish connections at its switchboard to rural lines not connected, except where lines are full metallic and have no more than ten subscribers per line. The Mineral Point exchange is now furnishing switching service to twenty rural lines, practically all of which have ground return.

MASSACHUSETTS COMMISSION.

The Massachusetts Gas and Electric Light Commission has approved a joint application of the Foxboro Electric Company and the Union Electric Light Company, of Franklin, relative to the purchase by the Foxboro company of the Union company's property and franchise. The commission has authorized the Union company to issue additional capital stock of the par value of $73,800 for the payment of all its bonds, notes and debt outstanding Nov. 1, 1911. By the agreement, the Union company sells to the Foxboro company its franchises, plant and other assets

and the Foxboro company is to issue and exchange its capital stock, share for share, for the capital stock of the Union company as it will be when the 783 shares mentioned above shall have been issued. The Union company is then to be dissolved. By an order issued simultaneously the commission authorizes the Foxboro company to issue 938 shares of additional capital stock to effect the purchase.

Current News and Notes

Commerce, the Commission and the Courts.—A lecture on this subject was delivered at Cornell University on May 13 under the auspices of the College of Arts and Sciences, by Mr. Logan G. McPherson, lecturer on transportation at Johns Hopkins University and director of the Bureau of Railway Economics. Copies of this interesting address have been reprinted for distribution and may be obtained by addressing Mr. McPherson at Washington, D. C.

* * *

Utilization of Energy from Los Angeles Aqueduct.—In connection with its municipal water-supply system the city of Los Angeles is considering a plan proposed by its chief electrical engineer, Mr. E. F. Scattergood, to distribute throughout the city electric energy produced at the generating station erected in connection with the water-supply system. It is estimated that to install a complete underground commercial and street lighting system will cost $16,500,000. It is proposed to finance the scheme by an assessment on the property of the city. The city charter makes provision for installing the distributing system under the assessment plan.

* * *

Construction Work of Illinois Traction System.—The Illinois Traction System, with headquarters in Peoria, Ill., controls a large number of electric light and power companies as well as street railway and interurban railway lines. Much construction work is planned for this year, including the installation of electric lighting service at Cerro Gordo, Oakwood, Fithian, Wapella and Mindale, Ill. It is interesting to note that thirty-four electrolytic lightning arresters for 700 volts will be installed at substations on the direct-current feeders for trolley lines. This protection is in addition to the 33,000-volt electrolytic lightning arresters used on alternating-current transmission lines at substations. Six substations not previously equipped with this type of arrester on the primary side will be supplied with it this year.

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High Central-Station Taxes in Milwaukee.—Of the $525,128 taxes levied by the Wisconsin State Tax Commission for the year 1912 upon the assessed value of the property owned and operated as of June 30, 1911, by all of the electric railway, light and power companies in the State, $296,572, or 56.4 per cent, is represented by the assessment upon the properties of The Milwaukee Electric Railway & Light Company. The total assessed valuation of the properties of all of the companies is $46,365,000, of which The Milwaukee Electric Railway & Light's proportion was $26,750,000. In order to pay the $296,572 tax on this valuation it will take 22 per cent of the net income of the company for the calendar year ended Dec. 31, 1911, as reported by the company to the Railroad Commission of Wisconsin. In addition to the state tax, the company has to pay annually city taxes of approximately $100,000 on real estate, etc., assessed by the city and not by the State, making a total burden for the year of nearly $400,000.

* * *

Chicago Electrolysis Situation.—Hearings before the Chicago Council committee on gas, oil and electric light on the subject of electrolysis have continued. Estimates have been submitted by the city electrician for the installation of a booster system which amount to between $4,000,000 and $5,000,000. However, all of the public utility companies concerned—with the exception of the gas company—are in favor of installing a drainage system, which it is said will not cost more than approximately $350,000. It developed at the hearings that a committee of nine members from the various companies interested has been secretly investigating the subject for several years and has gathered a large amount of information and data. It appears that the gas company has been spending between $7,000 and $10,000 a year in locating electrolytic damage to its underground system. The hearings will continue and evidence will be sought showing to what extent the underground cables of the telephone company have been damaged by electrolytic action.

* * *

SOCIETY MEETINGS.

Annual Convention I. E. S.—The 1912 convention of the Illuminating Engineering Society will be held from Sept. 16 to 19 at Niagara Falls, Ontario, Canada. The headquarters will be at the Clifton Hotel.

* * *

Illinois Contractors' Meeting.—At a meeting of the Illinois State Electrical Contractors' Association held in Rock Island on June 15, the following officers were elected: Mr. William McGuineas, Chicago, president; Mr. J. T. Merron, Peoria, vice-president; Mr. M. N. Blumenthal, Chicago, secretary, and Mr. J. N. Pierce, Chicago, treasurer. The next meeting of the association will be held in Peoria during January.

* * *

Northwestern Cedarmen's Association.—Twenty-one members of the Northwestern Cedarmen's Association, including President T. P. Bradley, of Duluth, and Vice-president W. C. Morse, of Minneapolis, made a tour of inspection of the white-cedar-producing territory of northern Minnesota. The trip proved so interesting to all concerned, from both the business and the recreation standpoint, that it is likely to become one of the annual affairs of the association.

* * *

Brooklyn Company Section N. E. L. A. Meeting.—The fourth annual convention of the Brooklyn Company Section, N. E. L. A., will be held at the Oriental Hotel, Manhattan Beach, N. Y., on June 26. Following the routine business the members of the section will be the guests of the Edison Electric Illuminating Company of Brooklyn at a banquet given at the hotel, after which addresses will be given by Mr. Samuel Insull, of Chicago, and Mr. W. F. Wells, assistant general manager and general superintendent of the local company. Election of officers for the coming year will follow the addresses.

* * *

Chicago Electric Club.—At a meeting of the Chicago Electric Club on June 13 the speaker, Mr. Max W. Zabel, of Chicago, defended the existing patent laws. He referred to the great value of the patent system to the public at large and replied in a general way to some of the criticisms which have been made against the existing conditions. Mr. Zabel did not concur in the view that there is any substantial abuse in the occasional practice of purchasing inventions in order to withhold them from use. The speaker agreed, however, that one of the serious evils under the present system is the great expense involved in patent litigation. He also referred to the practice of holding applications in the Patent Office as long as possible and declared that it ought to be corrected. The subject was then discussed briefly by Messrs. G. W. Cravens, E. A. Rummler, J. H. Delany and M. G. Lloyd.

ABSTRACTS OF N. E. L. A. CONVENTION PAPERS AND DISCUSSIONS

IN our issue dated May 4 was given the preliminary program of the National Electric Light Association convention held at Seattle on June 10-13. A telegraphic report of the opening sessions appeared in our issue for June 15. On page 1343 of this issue appears an account of those features of the convention of general interest from the point of view of their news value. Below are given abstracts of the papers and committee reports presented during the convention. The abstracts are arranged according to subject matter, without regard to the order of presentation or the sections of the association before which they were read and discussed.

REPORT OF THE PUBLIC POLICY COMMITTEE.

Of the many reports presented during the convention, probably none was of greater importance to the industry than that of the public policy committee. This report was prepared by a committee consisting of Messrs. N. F. Brady, E. W. Burdett, H. M. Byllesby, H. L. Doherty, C. L. Edgar, W. W. Freeman, J. F. Gilchrist, George H. Harries, Samuel Insull, J. D. McCall, T. E. Murray, Samuel Scoville, C. A. Stone and Arthur Williams, with Mr. Williams as chairman.

Attention was called to the existing and growing state of industrial unrest and dissatisfaction. The old order is undergoing changes no less real because the result is reached by changing public opinion rather than by physical effort. The committee urged that the member companies give careful consideration to their standing in the community they serve, and that the utmost care be exercised to eliminate on their part any condition leading to friction, criticism or a sense of injustice. The interests of the public are best served by giving public utilities the monopoly in the fields they occupy, thereby enhancing the capacity and stability of the generating plants. With extending and wise legislative control of the utilities and continued acceptance of the principle of regulative control, natural monopoly is beneficial and not harmful to the public and to central-station interests. Where monopoly of service is granted a higher degree of responsibility rests upon central-station men to become an important factor in that which makes for the larger and better development of the community in which their service is rendered. If possible, efforts toward good service, fair prices and courteous treatment should be greater than where competition is most keen.

The committee reported the organization during the year of the Municipal Ownership Publishing Company at 17 East Thirty-eighth Street, New York City, to maintain a library from which the general public may obtain quickly from all parts of this country and Europe the latest available information on the subject of municipal ownership. In addition it will issue a monthly publication in reference to the municipal ownership movement and its economic features. The publicity organization mentioned is planning to cover the entire field with accuracy, for the purpose of obtaining the economic facts, without bias or prejudice, and to follow a course that will win the confidence of writers, and through them of the public. The belief is that with the uncolored facts fairly presented the conclusions upon the municipal ownership question may be left with the public.

Among the central-station companies that have inaugurated welfare departments for their employees are the Commonwealth Edison Company of Chicago, Edison Electric Illuminating Company of Brooklyn, Edison Electric Illuminating Company of Boston, Philadelphia Electric Company, Cleveland Electric Illuminating Company, New York Edison Company, Milwaukee Electric Railway & Light Company, Consolidated Gas, Electric Light & Power Company, of Baltimore, and the operating firms of Stone & Webster and H. M. Byllesby & Company.

Attention was called to the fact that underpaid labor is not desirable in any industry, for the productive value of underpaid, and consequently underfed, men and women cannot equal that of those who have enough to provide at least the minimum required for good health and a reasonable degree of contentment. No community can afford to ask that a public service corporation shall underpay its employees, or pay to any a wage in which there is not sufficient allowance for relatively high standards of labor, no matter in what department of the industry the recipients may be engaged. Nothing can be more conducive to high service standards and public confidence and support than a satisfied, contented, strong, healthy and vigorous body of employees.

Discussion.

Mr. Samuel Insull, Chicago, who was unanimously selected by the public policy committee to present its report at the public meeting, discussed its importance and scope at some length after it was read. He explained that in reading the names and business connections of the various members of the committee he wished to bring out the important position which most of them occupied in the electric-light industry. He said that the committee represented not less than one-half of the money invested in the electric lighting and motor-service business in the United States, and that they were speaking with the responsibility of men who have the care of upward of a thousand millions of dollars of investment. Good business and not charity was the cause of the recommendations of the committee in those considerations which had to do with the welfare of employees, and in the estimation of the committee the cure for industrial trouble is to have contented employees. Since savings funds encourage thrift and lead to the acquisition of property, companies fostering such movements are raising the standard of their employees and rendering a public service.

Speaking on municipal ownership, Mr. Insull said that electric service can be rendered on the most economical basis only by the absolute concentration of production and distribution. Ignoring entirely the political aspect and considering the subject only from an economical standpoint, Mr. Insull maintained that the only way to get best results out of money invested is by concentration and by monopoly. From a study of conditions in New York and Chicago he stated that a proper concentration would have resulted in a saving of $150,000,000 in the former city during the past decade and of $75,000,000 in Chicago during the same time. He viewed the establishment of commissions to regulate natural monopolies as one of the encouraging signs of the times, as this is the only means by which competition can be eliminated in a business which from its very nature should be monopolistic. The relations of the association with manufacturers and bankers were also reviewed by the speaker as well as the relation of the United States government to the development of water-powers. Among the suggestions offered for the consideration of the public policy committee was the question of conservation and also the question of integrity of electric-light securities. At the conclusion of Mr. Insull's remarks, on motion of Mr. Lieb, the report was adopted, ratifying similar action that had been taken in the executive session earlier in the day.

Generation and Transformation.

HYDROELECTRIC DEVELOPMENT.

A paper presented by Mr. John C. Hoyt on the work and publications of the United States government relating to hydroelectric developments was a valuable résumé of the subject and showed the great extent to which the government is collecting important technical data of use to engineers. The government investigations are carried on by a large corps of technically trained men of special experience and are ordinarily made on a more thorough and systematic basis than are private investigations, which are frequently subjected to limitations of both time and expense. The government data of special value in connection with hydroelectric projects may be grouped under various topics, as follows: water supply, topography, geology, climate, social and industrial conditions, and experimental engineering data. The paper briefly reviewed the work of the various government bureaus and departments collecting data of the above character, and in conclusion gave explicit directions on how to obtain government records and publications. Those who desire to keep in constant touch with such information can subscribe for the Monthly Catalogue of United States Public Documents, which is issued by the Superintendent of Public Documents at Washington, D. C., and for which the subscription price is $1.10 per annum. Practically all government publications are issued in small editions, however, and they cannot be supplied to fill a large demand. In order to make all such publications generally accessible, copies are deposited in certain public libraries that have been designated as "government depositories." Additional important information is sometimes found in the files of the various departments and bureaus at Washington.

Discussion.

Considerable interest was displayed in this paper, which was read by Mr. G. L. Parker, Washington, D. C. It was discussed at some length by Messrs. J. Jacobs, Seattle; J. A. Britton, San Francisco; H. L. Doherty, New York, and W. N. Ryerson, Duluth. The first speaker called attention to the value of the paper in laying before engineers the comprehensive work being carried on by the government in relation to the development of water-powers. He expressed surprise that engineers have not been more generally informed of this work and made greater use of it than they have. This speaker especially commended the government papers on water supply and water-power. The work of the government was criticised only in respect of being insufficiently comprehensive. Many of the state governments are co-operating in this work, but as a rule they are seriously hampered by the lack of funds. Several speakers brought out the fact that there has been much mutual co-operation between the government and the large hydroelectric companies in gathering this information. In particular, the companies have been able to take the daily gage readings and supply information in regard to local rainfall. The chairman emphasized the desirability of continuing the study of the relation between rainfall and run-off. This is a complex question influenced by a large number of variable factors, which are dissimilar in different localities. Mr. Parker explained that a general study of the relation of run-off and rainfall has been carried out for the United States as a whole, thus furnishing general data on the subject. Much remains to be done, however.

PRIME MOVERS.

The sixty-five-page report of the prime movers committee was presented by Chairman I. E. Moultrop. It was divided into three parts dealing respectively with water, steam and gas power. In general the committee has continued the work of previous committees, giving careful consideration to the discussion of last year's report in connection with water-power. The use of vertical versus horizontal-shaft wheels was discussed at some length. The horizontal-shaft type is preferable in all cases except where the head is so low as to allow insufficient room to guide the water properly to and from the wheel. However, the difficulties with vertical-shaft wheels have recently been reduced to a minimum by the use of roller bearings for supporting the weight of the runner. The fitting of the runner occasionally gives trouble, and there is still some question as to the best runner material. In discussing governors and speed-limiting devices the committee expressed the opinion that there is still room for considerable improvement. The committee called attention to the benefits of operating steam-driven generating units in parallel with waterwheel units arising from the superior efficiency of governing devices for steam prime movers.

No marked development in steam prime movers has taken place during the past year. The principal changes in design have been in the direction of accomplishing minor economies and facilitating repairs. More attention is being given than formerly to the development of central-station auxiliary apparatus. The committee discussed at some length the methods of purchasing coal and pointed out the advantages of purchasing on an ash basis. The use of chain-grate stokers was recommended for burning low-grade coal running high in ash and volatile matter, but the use of such grates with fuels which tend to cake or run will probably result in burning the grate bars. This difficulty can be overcome to some extent by installing a water-back just in front of the bridge wall. It is possible to construct mechanical stoking furnaces so that they will be practically smoke-proof after the brick-work becomes heated. Steam-flow meters have not been perfected to a high degree of accuracy under average boiler conditions but are nevertheless accurate to a degree which makes them exceedingly useful. A meter of this character is a valuable adjunct to a boiler or a steam turbine for the purpose of showing the rate of output or consumption respectively. The committee pointed out the desirability of regulating feed-water supply to individual boilers in order to maintain a uniform steaming rate. The fatigue of cast-iron fittings when exposed to superheated steam was emphasized, and the committee strongly advised against the use of such material. Brief reference was made to the new method of burning gaseous fuel which was developed by Professor Bone, of England. This method depends upon the apparently new principle that gas burns more readily when in contact with an incandescent surface than it does in a free flame. It is reported that high efficiencies are obtained by this method. The committee called attention to the extensive use in Europe of high-efficiency reciprocating engines, such as the locomobile of the Stumpf, Wolf, Lenz and Memming types. In comparatively small sizes these types have attained a steam consumption as low as 16.5 lb. per kw-hr. Brief statements were included from two large manufacturers of steam turbines covering detailed improvements made during the past year. Efforts continue to be made in the direction of securing higher condenser vacuums, and radical changes in design have been made during the past two years with the object of so arranging the tubes and baffling the flow of steam that the entrained air will be swept toward the vacuum pump suction and the steam side of the tubes readily freed of condensation. Substantial improvements have been made in speed reduction gears for steam turbines. Such equipment has been installed on the United States collier *Neptune*.

In discussing gas power, the committee dwelt at some length on the available sources of oil for prime mover purposes and touched upon the preparation of specifications for engine fuel oil. It is quite essential to obtain oil that

is free from acids, asphaltum and non-combustible solids. In both Germany and the United States gas-house tar has been successfully used in engines of the Diesel type. The superiority of engines of the Diesel type as regards fuel economy has been very well established. The following figures were given for oil consumption with engines of different types: Diesel, 0.5 lb. per brake hp-hr.; De La Vergne, 0.6 lb. per brake hp-hr.; Hornsby-Akroyd, 1 lb. per brake hp-hr. The oil in each case is assumed to contain 18,500 heat units per pound. The committee included a table giving very complete data on thirty-eight oil-engine plants, showing the cost of operation and describing the results obtained. A full summary was presented of the troubles experienced in operating and maintaining twenty-one engines of the Diesel type, in different installations, and sixteen of the De La Vergne type. The committee did not attempt to enter extensively into the subject of gas engines; this was thoroughly discussed in the 1908 proceedings of the association. Coal-gas producers are successfully meeting demands where the load-factor is high and fuel relatively expensive. Experimental gas turbines as large as 1000 hp have actually been built and operated, but reliable information in regard to them has not been received.

Discussion.

Unusual interest was manifested in many features of this report, which was abstracted by Mr. J. B. Klumpp. Among those who took part in the discussion were Messrs. B. J. Denman, Detroit, Mich.; P. Junkersfeld, Chicago, Ill.; C. W. Stone, Schenectady, N. Y.; L. Kemper, Albert Lea, Minn.; R. D. De Wolf, Rochester, N. Y.; T. H. Yawger, Rochester, N. Y.; J. A. Lighthipe, Los Angeles, Cal., and J. H. Egan, Kansas City, Mo. It was pointed out by one of the speakers that the high efficiency of the large boiler units in the Delray station at Detroit is due primarily to the features of design and cannot be accounted for by unusual care in operation or by the selection of fuel of more than average quality. Two of these boiler units are used to supply steam for one 14,000-kw turbo-generator, but each unit can easily carry a maximum load of 8000 kw. The efficiency curve of these boilers is remarkably flat. The cost of setting and the expense of furnace repairs are both unusually low.

Several speakers indorsed the use of steam-flow meters on boiler and turbine units for checking the operation. In modern central stations it is highly essential to watch the efficiency of operation, and the steam-flow meter meets a long-felt want. In connection with the use of fuel oil under steam boilers it was brought out that the vaporization of the oil requires, on the average, about 2 or 2.5 per cent of the total steam delivery. It is expected that with mechanical burners the steam consumption can be reduced to 1 per cent. The use of oil engines was said to be satisfactory in sizes up to 250 hp with the single-cylinder type and up to double this output with the two-cylinder type. Another speaker voiced the opinion that the Humphrey gas pump is one of the fundamental inventions of the age and destined to play an important part in future developments.

ELECTRICAL APPARATUS.

The committee on electrical apparatus, Mr. L. L. Elden, chairman, presented a comprehensive report of fifty-five pages on generating station and substation apparatus, intended to be a continuation of the work commenced by the previous committee. The body of the report was very brief, while the principal details were presented in a voluminous illustrated appendix. The report is well worth the careful study of all central-station engineers.

The committee directed particular attention to a number of improvements, which are briefly outlined in what follows. The demand for higher economy, particularly in steam turbine operation, has led during the last two years to the adoption of still higher speeds, especially on medium-size and large-size units. In view of the brief experience with such units special care should be given in the preparation of specifications to insure safe and reliable operation, especially in connection with reactance, temperature rise, ventilation and ruggedness. Owing to the progress of development, the committee made no definite recommendations on speed limitations. The committee also pointed out the economic advantages of very large generating stations and extensive networks for distribution, which are becoming better known. Enormous possibilities for progressive central-station companies are opening up along these lines. There is, therefore, an increasingly strong demand for 60-cycle synchronous converters for railway purposes, and the committee strongly urged further improvement in the design and construction of such equipment. The committee was not in favor of adding to the investments in 25-cycle transmission lines and converting apparatus.

Developments during the year indicate a demand for simpler and more rugged switchboard equipment in substations, particularly in small substations which do not have continuous attendance. Iron-clad switch gear is being used abroad to some extent and is being favorably thought of in this country; the committee recommended that it receive careful consideration.

Power-limiting reactances have been successfully installed in a number of cases. Induction generators have not been generally adopted, but several prominent companies, including the Interborough Rapid Transit Company of New York City, have installed and operated them with excellent results. The operation of oil switches has been improved by the modification of the baffles inside the tanks and the strengthening of the insulators and supports. The committee called attention to the possible hazard to employees from instrument transformers and mentioned a case where a man was killed by touching the name plate, which was crossed with the primary winding. The committee also recommended that the manufacturers continue their efforts to increase the tube life in mercury-arc rectifiers.

Discussion.

This report was discussed by Messrs. C. W. Stone, Schenectady, N. Y.; W. N. Ryerson, Duluth, Minn.; T. H. Yawger, Rochester, N. Y., and S. Q. Hayes, East Pittsburgh, Pa. Mr. Stone stated that in the matter of substation equipment it is the practice in Europe to provide for interchangeable operation for railway and lighting service. This is accomplished by connecting in series two synchronous converters each giving a pressure of 300 volts. Railway service is supplied at 600 volts and lighting service at 300 volts. With reference to iron-clad switch gear, the speaker stated that his company has placed such equipment on the market in England and can supply it in America if desired. The use of power-limiting reactors is most important in low-frequency systems. Auto-transformers for this purpose are not as satisfactory as air reactors, since the presence of the iron core is a disadvantage. This is not serious, however, if the iron is not saturated under short-circuit conditions. It is decidedly preferable to use external reactors, instead of designing generators with sufficient internal reactance to limit the delivery of power to a safe maximum.

The speaker expressed his preference for auxiliary or isolated exciter systems in central stations. It is preferable, in his opinion, to drive an exciter with a non-condensing turbine and employ motor drives for all other auxiliaries. He stated that the practice of designing transformers with a minimum internal reactance is not desirable in the case of high-tension equipment. He recommended that systems operating at pressures of 75,000 volts or higher should be delta-connected. This will permit the use of arcing ground suppressors. The speaker did not favor the use of the

Merz-Price system for the conditions of operation that are found in America.

Mr. Ryerson described the use of an induction motor on the shaft of a water-wheel-driven exciter for fulfilling the function of a speed governor. He recommended tying exciter sets to the busbars without the use of reverse-power relays. The speaker also was in favor of reducing the number of switchboard instruments to a minimum. Mr. Yawger described a modification of the Merz-Price system which has been tried very successfully in the central-station system at Rochester. Mr. Hayes stated that in his opinion it is as desirable to design generators with high internal reactance as it is to employ external reactors. He also stated that iron-clad switch gear has been placed on the English market by his company.

Mr. Elden in closing the discussion stated that it is possible to work out many modifications of the Merz-Price system. He replied to some criticism in regard to the use of reverse-power relays by saying that much depends on the quality of the relays obtainable. At present they are not over-reliable. The pilot wire in the Merz-Price system costs about $1,000 per mile.

TRANSFORMERS.

A comprehensive illustrated paper on the care and operation of transformers was prepared by Mr. W. M. McConahey. The author pointed out in general that the large high-voltage transformers now coming into general use require a certain amount of care and attention in order to give satisfactory service. The paper dealt mainly with oil-insulated transformers but referred briefly to the air-blast type. The two primary essentials in transformer design are insulation and heating. Perhaps the most important matter in connection with oil-insulated transformers is the matter of keeping the oil in proper condition. Moisture in the oil is the most insidious fault which can occur and should be carefully guarded against. An exceedingly simple and satisfactory way of keeping the oil clean and dry is to install a de-hydrating outfit. This can be so arranged in the case of large transformers that the oil may be cleaned and purified without taking the transformer out of service.

Self-cooling transformers are at present being built in sizes up to about 3000 kw. Larger sizes than these have to be water-cooled. The ordinary water rate is one-fourth of a gallon per minute per kilowatt of loss. Large transformers should be periodically inspected about once in six months, at which time the oil should be tested, and the cooling coils should be examined to determine whether they have accumulated deposits from the oil or scale from the water. The water-cooled transformer should not be operated more than a short time without its normal circulation of water. Air-blast transformers form a class by themselves and their use is comparatively limited. They require about 150 cu. ft. of air per minute for every kilowatt of loss. Transformers of this type will quickly reach a dangerous temperature if the air blast is shut off while carrying full load. Air-blast transformers should not be wound for pressures exceeding about 35,000 volts because of the insulation difficulties encountered. When two or more transformers are to be operated in parallel or connected in banks on a polyphase system it is necessary to know their polarity in order to connect them properly. The author devoted the latter half of his paper to a consideration of the numerous polarity combinations in polyphase banks, making extended use of potential diagrams.

Discussion.

Owing to the time consumed in the discussion of the preceding reports and the absence of the author of this paper, it was necessary to have it read in abstract, and this was done by Mr. S. Q. Hayes, East Pittsburgh, Pa. No time remained for discussion.

Transmission and Distribution.

GROUNDING SECONDARIES.

The chairman, Mr. W. H. Blood, Jr., presented the report of the committee on grounding secondaries, recommending in brief that secondary alternating-current circuits, carrying not more than 150 volts, should invariably be grounded. The report called attention to the fact that this question has received extensive consideration for several years past, and stated that the various bodies interested in the matter, including the American Institute of Electrical Engineers, the Association of Edison Illuminating Companies, the National Electrical Inspectors' Association and the National Electric Light Association, have at last unanimously agreed upon the policy of grounding. At a conference held in New York on March 12 of this year it was unanimously voted to recommend to the electrical committee of the National Fire Protection Association certain changes in Rule 15 of the National Electrical Code. The recommended changes provide that transformer secondaries of distributing systems must be grounded when the maximum difference of potential between the grounded point and any other point in the circuit does not exceed 150 volts. If no neutral point or wire is accessible, one side of the secondary circuit must be grounded. If the maximum potential difference exceeds 150 volts, grounding may be permitted. Water companies and municipal departments in charge of water-works are urged to allow the attaching of ground wires to their piping systems, without fear that damage will result. At a meeting of the electrical committee of the National Fire Protection Association held on March 22 of this year it was voted to approve these recommendations and to present them at the 1913 meeting for the revision of the code.

Discussion.

The discussion of this paper was opened by Mr. Farley Osgood, of Newark, N. J., who stated that the association owes a deep obligation to the members of this committee who have labored so faithfully for the past five years in the effort to obtain unanimous agreement among all concerned in the matter of grounding transformer secondary circuits. Now that this object has been accomplished, it is highly essential for all member companies to place the new rules in effect as promptly as possible, and a step can immediately be taken in this direction by enforcing the new rules hereafter on all new installations. Operating men still have a problem before them in the development of satisfactory types of artificial ground connections, which is an important matter and ought to be taken up without delay. The speaker offered a resolution that the report be adopted by the technical section and then referred to the executive session with the recommendation for adoption by the association as a whole. This motion was immediately carried. Chairman Eglin added a few words of commendation to the work done by the committee and expressed the opinion that the association as a whole should immediately adopt the report.

In response to a question by Mr. L. B. Faulkner, Olympia, Wash., in regard to the cost of installing grounds, Mr. Blood replied that the cost varies considerably, owing to different local conditions, but a fair average is probably from $6 to $8, or perhaps as high as $10, each.

ACTIVITY IN TRANSMISSION UNDERTAKINGS.

Mr. Henry L. Doherty, as chairman, briefly sketched the history of the transmission section, referring to its original organization at the St. Louis convention in 1910. The controlling motive in forming this section was the need of discussing hydroelectric development and energy transmis-

sion in their broadest aspects, including the points of view of electrical, mechanical and civil engineers, operating men, energy users and bankers. The chairman expressed his hope that the section would grow in size and importance until it becomes a rival of the commercial section, which has been in existence eight years and now has some 1200 members. Mr. Doherty emphasized the facts that very large quantities of water-power yet remain undeveloped and that there are many possible uses for it in electrochemical industries, irrigation and numerous applications on the farm. There is a great need of further development in the art of constructing inexpensive high-tension transmission lines in order to stimulate the development of water-power.

In this connection the speaker voiced his well-known views on the subject of conservation of natural resources and expressed his conviction that the present policy of the federal government is highly obstructful and wasteful. Mr. Doherty declared the theory that forest area is essential to the proper regulation of stream flow to be a fallacy and held that tilled soil is fully as effective. In his opinion, the present conservation policy is responsible for sending many of our Western settlers to Canada and also responsible for encouraging capital to enter other and more attractive fields. The speaker deplored the continued tendency in the magazines toward "muckraking" attacks on American business methods and pointed out that this has done much to create distrust in the public mind and that it reacts against national prosperity.

OVERHEAD-LINE CONSTRUCTION.

The committee on overhead-line construction, of which Mr. F. Osgood, Newark, N. J., is chairman, had not prepared a formal report in advance of the meeting, on account of arrangements under way which the chairman explained. A year ago this committee presented a very important and comprehensive report at the New York convention. The section of that report dealing with railroad transmission-line crossings was prepared in joint conference with a number of other associations of national character, and Mr. Osgood proceeded to explain what steps had been taken during the year by these associations in formally adopting the report. Shortly after the New York convention the legal counsel for the association examined the report carefully and considered the possibility of any legal embarrassment which might arise from formal indorsement by the association as a whole. A favorable opinion was received, and in December the executive committee formally approved the report. Shortly after the New York convention the Association of Railway Telegraph Superintendents adopted the report verbatim without discussion.

The report was soon afterward taken up by the American Electric Railway Association and approved by the technical section of that body, which recommended the report to its standards committee. Mr. Osgood stated that the railway association would add a few phrases embodying minor changes and that the subject would come up for formal consideration at the annual convention during the fall of the present year. When the report was taken under consideration by the American Railway Engineering Association there was a desire to make numerous changes increasing the stringency of the requirements. At the last convention, in March of this year, however, a compromise was reached after considerable discussion, resulting in the proposal to change only some of the provisions of Section 18, relating to strain insulators in guys. The speaker stated that, in his opinion, the National Electric Light Association could well afford to accept the compromise proposed by the Railway Engineering Association.

The proposed changes in Section 18 are as follows: "Strain insulators shall be used in guys from wooden poles carrying any power wire of less than 6600 volts, provided that the guys are not through-grounded to permanently damp earth. Strain insulators shall not be used in guying steel structures, nor required on wooden poles carrying wires all of which are at 6600 volts or more, provided the guys are through grounded to permanently damp earth."

Discussion.

Some discussion on the changes in this section took place between Chairman Osgood and Mr. J. A. Lighthipe, Los Angeles, who pointed out that in California, for example, it is necessary to modify the association's specifications somewhat in order to conform with local statutes. The motion to ratify the proposed changes in Section 18 was then put to a vote and carried, and it was next voted to refer this section to the general session, with a recommendation that it receive the approval of the association as a whole.

Chairman Osgood referred to certain controversies which had arisen in connection with the use of clamping devices in 2400-volt line work. On account of some differences of opinion which had arisen, he submitted for publication in the *Proceedings* the following interpretation of Paragraph 1 of Section 4 of the 1911 report, also recommending that this interpretation receive the sanction of the association: "The interpretation of the National Electric Light Association of Paragraph 1 of Section 4 of the report of the overhead-line construction committee, as presented at the 1911 convention, is that the ordinary tie form of construction is proper for all 2400-volt railroad crossings, provided the construction conforms to the requirements of Section 1 of the report and applies only to voltages and conditions as covered therein and where the crossing span does not exceed 125 ft."

The other associations were unable to adopt this particular clause of interpretation inasmuch as it referred to parts of the 1911 report of the committee which did not concern them in any way. The situation seemed to be best met by placing the above statement of interpretation officially on file in the *Proceedings* of the association.

The chairman referred in detail to some recent tests which had been carried out on tie wires and stated that he would insert for publication in the *Proceedings* the report of a number of interesting tests made at crossings on the Pennsylvania Railroad near Philadelphia and Trenton.

REPORT OF TRANSMISSION COMMITTEE.

The chairman of the transmission committee, Mr. J. R. McKee, New York, was unable to be present, owing to the recent death of Mr. Hinsdale Parsons. In his absence the report was read by Mr. D. B. Rushmore, Schenectady, N. Y., and an abstract is given in what follows: Owing to the character of the committee membership it was very difficult to hold meetings during the year. The committee reported that it was unanimously of the opinion that water-power franchises should run for an indeterminate time, a position which was concurred in by the American Institute of Electrical Engineers. Members of the committee gave some attention to legislation and appeared before committees of Congress to give testimony in reference to the best policy to be followed in developing water-power sites. The withdrawal of government lands was declared to have stifled development in the West. The reaction has stimulated hydroelectric development in the South. The Niagara Falls situation was discussed, and it was pointed out that the use of 20,000 cu. ft. per second more of water would detract in no detectable degree from the scenic grandeur of the Falls and would add 500,000 hp to the utilized supply. The report declared that if we were to waste our coal deposits as rapidly as we are allowing our water-powers to run to waste there would instantly be loud protest from the public. Reference was made to Senate bills Nos. 6795 and 6796, introduced by Senator Burton and providing for the development of water-power sites on the public domains.

These bills are not satisfactory. The present restrictions on the development of water-power sites withdrawn from entry were declared to be extremely burdensome, and it was pointed out that the supreme need of the moment is education of the public on these questions.

Discussion.

Chairman H. L. Doherty indorsed the conclusions presented in the report and then repeated the closing portion of his address to the transmission section delivered the evening before. He again took occasion to comment on the disastrous effects of magazine "muckraking" on American business. Particularly, the sentiment prevails in Europe, he said, that American business men are not to be trusted. In the speaker's opinion the men who are exploiting the modern theories of conservation are in fact searching for political issues.

HIGH-TENSION SWITCHBOARDS.

A well-illustrated paper on high-tension switchboard practice was presented by Mr. Stephen Q. Hayes. The scope of the paper was somewhat broader than the title indicated and treated not only the panel, pedestal and bench types of switchboard but also other features of generating station and substation apparatus, as well as some of the general features of station design. The paper was mainly descriptive, including illustrations of the following installations: Tacoma Municipal Plant, Mount Hood Power Company, Olympic Power Company, Winnipeg Municipal Plant and the Hydro-Electric Power Commission of Ontario.

Discussion.

A brief discussion of this paper was participated in by Messrs. A. J. Bowie, Jr., San Francisco; D. F. McGee, Portland, Ore., and L. N. Peart, Fresno, Cal. The speakers brought out the fact that small substations of the outdoor type are now in use in numerous places. Equipment for installations of this character has not, however, been fully developed. There has been trouble in some instances from the overheating of self-cooling transformers in hot weather, but this difficulty is easily overcome by the use of water-cooled transformers.

ENERGY TRANSMISSION PROGRESS.

A second part to the report of the committee on progress, presented by Chairman T. C. Martin, was devoted extensively to the subject of energy transmission. This is the first occasion on which the progress committee has divided its report, the division now being made at the suggestion of Past-president Doherty, chairman of the transmission section. This thirty-nine-page report was subdivided under ten topics, including legislation, power sources, combined steam and hydroelectric plants, aluminum conductors and high-voltage plants. The recent report on water-power prepared by United States Commissioner of Corporations Smith was declared to place an unfair construction on the processes of consolidation and corporate combination which have been going on in this field. Attention was directed to the hearings before the National Waterways Commission, at which the association recommended the principle of indeterminate franchises for the proper regulation of water-power corporations. Referring to energy sources, the committee mentioned the rather sensational proposal advanced by Sir William Ramsay, of London, for the subterraneous generation of gases in coal deposits and their immediate utilization in gas engines. Proposals for the international exchange of energy at Detroit, between the United States and Canada, were briefly discussed. Reference was also made to the court decision annulling the Wisconsin water-power law. A few unusual instances were mentioned in which electric energy generated from municipally owned water-power is being sold to public utility corporations.

Auxiliary steam stations for hydroelectric systems were discussed in some detail, making reference to the plants of the Hartford (Conn.) Electric Light Company and the Southern Power Company. Considerable attention was devoted to the use of aluminum conductors by a number of Canadian transmission companies and also by the Ontario Hydro-Electric Power Commission. New hydroelectric developments were referred to on the Broad River (N. C.) for the North Carolina Electric Power Company, at Lloyds Shoals for the Central Georgia Power Company, at Coleman (Cal.) for the Southern California Power Company, and on the Snake River (Idaho) in connection with the Minidoka reclamation project.

References were made to a number of transmission systems now operating at 100,000 volts or more, including the 110,000-volt line at Lauchhammer, Germany, and the 140,000-volt line of the Au Sable Electric Company in Michigan. The Keokuk project was briefly described, and a very brief reference was made to the proposed 1,000,000-hp development on the St. Lawrence Rapids near Montreal. Other new projects in Oregon, Idaho, Vermont and the South came in for mention.

Discussion.

Inasmuch as the special features of the program had consumed most of the time available for the session, the report of the committee on power transmission progress was read by title, in order to leave the few moments remaining for the presentation of the last paper on the program.

UNDERGROUND CONSTRUCTION.

Mr. W. L. Abbott presented for the committee on underground construction a very interesting report, divided under four heads, as follows: alternating-current underground distribution, manhole construction, electrolysis, and high-tension cable data and specifications. The subject of alternating-current underground distribution was chosen on account of its growing importance, which arises from the tendency of municipalities to eliminate overhead systems in the more thickly settled residential districts. Replies pertaining to this type of underground distribution were received from twelve large operating companies and were grouped in a large table for comparison. The committee particularly emphasized the importance of keeping complete records of subway equipments and the great desirability of maintaining a record of subway troubles. A strong recommendation was also included to make systematic inspections.

The subject of manhole construction was considered on account of its important bearing on underground distribution in general. Manholes are commonly constructed of brick, monolithic concrete or concrete blocks. The manhole practice adopted by eleven large central-station companies was well presented in tabular form. Tables and curves showing manhole costs were included. The subject of high-tension cable data and specifications has not hitherto had due attention and was therefore taken up by the present committee. Data were again collected from the largest central-station companies and presented in tabular form. The working pressures vary from 5500 volts to 25,000 volts, and the total length of cable covered by the reports is 1912 miles. All of this cable, except 69 miles, is paper-insulated and impregnated with compound. A form of standard specification was submited for consideration. Probably the most important work done by the committee was in the collection of information relating to electrolysis of sub-surface structures. The committee first sent out a list of nineteen questions to all the member companies in cities having a population above 100,000. Definite and complete replies were received from companies operating in twenty-nine of the principal cities, and these were summarized in tabular form. In only four of the cities are there any municipal regulations prescribing the maximum

permissible drop in the track return. No litigation is in progress against the companies in any of these cities, although the preliminary steps have been taken in three instances. The answers in reference to the systems of protection in use indicate that the so-called parallel system is the most popular, while the drainage system is second in preference. Among the lighting companies there is considerable difference of practice in bonding their cables to gas and water pipes and telephone cables. In one instance a railway company has obtained very satisfactory results by disconnecting the rails from the negative busbar and extending insulated negative return feeders for some distance from the station and connecting them to the rail network. Several lighting companies connected the neutrals of their three-wire systems to the rail return, but found that this practice upset the balance in the three-wire system and were forced to discontinue it. The committee observed that there has been a general failure to take up the subject of electrolysis along comprehensive lines in an effort to solve the problem simultaneously for all of the utility companies involved. Among the specific remedies considered were the following: the double-trolley system, the insulated negative return feeder system, the three-wire control system, the parallel circuit system, insulating cable joints, water conduits and the drainage system.

Discussion.

After listening to a brief abstract of the report by Mr. S. B. Way, of Milwaukee, Wis., one of the members of the committee, a general discussion was participated in by Messrs. L. L. Elden, P. Junkersfeld, Chicago, Ill.; S. C. Lindsay, Seattle, Wash.; C. J. Wilson, San Francisco, and E. R. Northmore, Los Angeles. The report of the committee was highly commended by Mr. Elden, who contributed at some length to the discussion. He pointed out the advantages of fiber or wood ducts in protecting cable sheaths from mechanical injury and electrolysis. He also recommended the policy of not carrying more than sixteen cables into a single manhole and pointed out the desirability of providing for ventilation by the use of perforated manhole covers. Careful attention should also be given to the matter of bonding cable sheaths. This speaker also declared that much greater vigilence was demanded in the preparation of specifications for high-tension cables and recommended the requirement of a test at double the working voltage. He was also in favor of requiring the manufacturer to furnish a five-year guarantee. Much further investigation is needed, in Mr. Elden's opinion, of the safe temperature limit at which underground cables can be operated.

The situation regarding damage to underground structures from electrolysis in a large Western city was briefly related by Mr. Junkersfeld. The local city administration sought to make a political issue out of the situation and prepared a very drastic ordinance which would require the street railway company to make an immediate expenditure of from $3,000,000 to $5,000,000. A careful study of the situation by experts revealed the fact, however, that the application of the drainage system would eliminate at least 90 per cent of the trouble at a cost of only $300,000.

Messrs. Wilson and Northmore brought up the difficulties attending the use of inclosed fuses in 2300-volt underground systems and the desirability of developing a satisfactory type of junction box. In closing the discussion, Mr. Way stated that the probable cost of junction boxes is too high to consider their development. He cited an instance in which one company had obtained satisfactory results with oil-immersed fuses.

RECEIVING APPARATUS.

Chairman F. B. H. Paine presented the report of the committee on receiving apparatus for use on transmission lines. The report was necessarily brief owing to the fact that the committee was not appointed until February of the present year. In a condensed discussion of the causes of transmission-line disturbances and interruptions the committee submitted the following suggestions: The most important thing is not to cut out equipment until it is necessary or until the disturbance is shown to be more than momentary. Inverse-time-limit relays should not be permitted. When maximum continuity of service is the first essential it is preferable to employ induction motors instead of those of the synchronous type. Where the use of synchronous apparatus is unavoidable it is desirable to provide separately driven exciters or a separate source of supply for the field excitation. No doubt exists as to the benefit derived from the use of heavy copper dampers on the pole faces of synchronous machines. The committee particularly recommended the development of apparatus for keeping a continuous record of system disturbances in order to know their actual time of occurrence and their duration, with the object of afterward carrying on such investigation as may be necessary to remove the causes.

Discussion.

Mr. W. N. Ryerson, Duluth, who read the report, offered a motion that the committee be continued for another year. This was seconded and carried. Chairman H. L. Doherty took occasion to say that while the committee's report was comparatively brief it has nevertheless done a great deal of work on the subject during the year. Among those who discussed the paper was Mr. D. F. McGee, Portland, Ore., who directed attention to the fact that in supplying small towns with energy from high-tension lines having unattended substations the chief problem is one of protection. His company has adopted a pole-top switch with horn-gap and uses glass fuses about 3 ft. in length. Difficulty sometimes arises through the blowing of a single fuse, which overloads the transformer which remains in service and sometimes causes it to burn out. Mr. J. A. Lighthipe, Los Angeles, spoke of his observations on the aging of insulators, especially those of the pin type. About two years after the first installation his company began to experience insulator failures and now finds it necessary to make periodical inspections every six months. On such inspection trips the lineman strikes each insulator with a hard wooden stick, and if the porcelain fails to ring true, thus indicating a crack, the insulator is immediately replaced. He anticipates that five years from the date of the original installation all of the pin-type insulators will have been replaced. Although much effort has been expended in trying to locate the cause of these failures, he stated that no satisfactory explanation has yet been offered.

Continuing the discussion, Mr. P. T. Hanscom, San Francisco, described twelve recent failures of suspension-type insulators installed as strain types in the system of the Great Western Power Company. In each case the jumper held the phase wire clear and the interruption to service was only momentary. Apparently the combination of mechanical and electrical stresses had something to do with these failures. These strings consisted of four two-part units, and they were replaced with strings of five single-part units. Mr. Hanscom recommended greater liberality in the allowance of a factor of safety and pointed out that the companies which have employed a high factor of safety in insulation seem to have experienced the fewest troubles. In closing the discussion, Mr. Ryerson emphasized the need of developing an inexpensive type of circuit-breaker to serve as a substitute for fuses. He also brought out the fact that the failure of porcelain insulators may be due in some cases to the internal stresses caused by unequal shrinkage in cooling.

CORONA ON HIGH-TENSION LINES.

A very interesting paper on the occurrence of corona on high-tension lines was presented by Mr. G. Faccioli. The

author treated the subject under three heads: First, the reason for regarding corona as a dangerous phenomenon; secondly, the conditions under which it will occur, and lastly, the measures for its prevention. The presence of corona indicates in general that the dielectric strength has been exceeded, and while no danger may result at the normal operating voltage, the formation of arcs may occur during momentary or transient rises of potential. Another danger from corona is the possible disintegration of conducting and insulating materials through the production of ozone, oxides of nitrogen and nitrous or nitric acid. Furthermore, corona produces local heat. While in the main it is a high-tension phenomenon, it may occur at comparatively low voltages if the conductors are small and the distance between them is very limited. This may happen in the windings of generators, motors or transformers. The phenomenon becomes of particular importance on high-tension transmission lines, as indicated, for example, by the fact that some of the modern lines have been designed to operate at an emf just below the critical voltage of visible corona. The occurrence of corona increases the line losses slowly at first, as the voltage rises above the critical limit, and then at a rapidly increasing rate.

It has often been considered commendable to operate a transmission line very close to the critical voltage, in order, by the dissipation of energy, to damp high-frequency oscillation and diminish the intensity of transient impulses. It is not known, however, whether transient voltages of great magnitude and exceedingly brief duration are simultaneously accompanied by corona. One of the interesting discoveries already made is the fact that in the case of direct-current lines there is a difference between the characteristics of corona on the positive conductors and those on the negative conductors.

Corona naturally appears where the gradient of the electric stress exceeds the critical disruptive voltage of the dielectric. This may happen, of course, at the surface of conductors which are too small, or at the ends of open conductors, and quite generally at sharp bends, points and projections. The means of preventing corona consist in general of diminishing the steepness of the potential gradient. This can be done, for example, by placing metallic spheres or disks at regular intervals along the conductor, or by placing two conductors in parallel within a short distance of each other. The author presented a curve showing for the last case how the critical voltage increases as two wires, parallel both geometrically and electrically, are brought closer together. He also showed how corona may occur at transformer leads, at roof and wall bushings, and also at busbar supports. Difficulties of the latter character can be minimized by the use of insulated concentric metallic bushings, constructed after the manner of the so-called condenser terminal.

The paper closed with a well-illustrated description of the 140,000-volt, 125-mile transmission system in Michigan operated by the Au Sable Electric Company. A curve was presented showing the corona loss in kilowatts per mile for various line pressures. It was also pointed out by the author that the unusually large charging current on this line causes a progressive rise of voltage from the generator end to the receiver end. At 140,000 volts impressed potential, with the receiving transformers connected but not loaded, the receiver pressure is 165,000 volts. It is expected, however, that when the system is fully loaded the line voltage will be substantially constant at 140,000 from end to end. Various construction details of the high-tension portion of the system were described.

Discussion.

Considerable interest was manifested in the phenomenon of corona. The paper was discussed by Messrs. D. B. Rushmore, Schenectady, N. Y.; S. Q. Hayes, East Pittsburgh, Pa.; F. D. Nims, Vancouver, B. C.; F. M. Kerr, Butte, Mont.; C. W. Stone, Schenectady, N. Y., and A. J. Bowie, Jr., San Francisco. The nature of corona and its characteristics were explained with some care by Mr. Rushmore, who pointed out that the continued occurrence of corona is accompanied by dark-brown deposits on the pins and insulators. Mr. Hayes spoke of the frequent occurrence of corona at the blades and connections of open-air disconnecting switches. In order to avoid this result the disconnecting switches in the 110,000-volt installation on the Canadian side of Niagara Falls are constructed of tubing.

Mr. Kerr gave an interesting account of the occurrence of corona in the Butte substation, where it has apparently caused the disappearance of the glaze from the porcelain insulators, in the region under the tie wires, and caused the erosion of the face of the brickwork in the high-tension bus compartments. On this system a marked increase in the line loss has been observed during rainstorms. Mr. C. W. Stone, of Schenectady, N. Y., referred to the occurrence of corona at entrance bushings and mentioned several methods of preventing it. He explained that corona is not exclusively a high-tension phenomenon, but he has seen it occur at pressure as low as 2300 volts. In response to an inquiry by Mr. Bowie regarding the possibility of a phenomenon in oil similar to corona in atmospheric air, Mr. Rushmore replied that it may possibly exist, but no investigations have up to this time been undertaken in that direction.

LIGHTNING PROTECTION.

The brief report of the committee on protection from lightning, presented by Mr. S. D. Sprong, chairman, was devoted almost entirely to a consideration of the best means of carrying on the work which falls within the committee's scope. In view of the knowledge and data thus far gained of lightning phenomena, it was felt that further work along established lines could yield little additional material of substantial value. At the same time it is very important to carry on investigations looking toward the solution of a number of important problems, but these investigations require the trained observation of experts and should be facilitated by the development of special apparatus for automatically making a continuous record of lightning disturbances. The committee, therefore, recommended that it be given an appropriation to carry on experimental investigations in representative systems along the lines suggested, and it was further pointed out that the committee work can yield valuable results only if continued from year to year for a considerable period of time, thus enabling the work to be properly systematized.

Discussion.

After listening to the reading of this report by Mr. H. B. Gear, of Chicago, the discussion was opened by Mr. D. B. Rushmore, who described the early efforts to obtain records of discharges in multiple-gap lightning arresters, and then spoke of the characteristics of the later aluminum-cell type of arrester. He recommended that each transmission company in the association employ a lightning expert who could co-operate with this committee and assist in carrying out the elaborate investigation of lightning disturbances which ought to be made without further delay. This proposal was indorsed by Mr. Gear. The last speaker then asserted that the majority of the member companies are more interested in the problem of lightning protection on 2300-volt distribution systems. He stated that an elaborate investigation of this phase of the problem is now being carried on in Chicago and will be continued for a period of several years. Mr. Gear then moved that the recommendation of the committee for an appropriation to carry on the work be indorsed and referred to the executive committee of the association. This motion was seconded and carried.

Utilization.

ELECTRICITY ON THE PANAMA CANAL.

Mr. D. B. Rushmore, secretary of the transmission session, delivered a lecture on the electrification of the Panama Canal in construction and operation. As a necessary adjunct to the proper understanding of the lecture Mr. Rushmore reveiwed briefly the early history and the main constructional features of the great undertaking on the Isthmus. He claimed that, although electricity has played only a small part in the work at Panama, there can be no question as to its applicability and its better efficiency. The American people, however, demanded that the work be pursued with all speed, and steam and compressed-air machinery having already been developed for work of this kind, they were naturally used. Mr. Rushmore then showed by means of numerous lantern slides the various uses to which electricity is being put and will be put on the Panama Canal.

ELECTRICITY IN IRRIGATION.

A comprehensive illustrated paper on the use of electric energy for irrigation and for farm work had been prepared by Mr. C. H. Williams. Most of the paper was devoted to a very excellent symposium on the art of irrigation. Wherever the annual precipitation is less than an average of 20 in., agriculture cannot be carried on successfully without an artificial supply of water. There are 300,000,000 acres of land lying immediately east of the Rocky Mountains which only require irrigation to make them exceedingly fertile. Three methods of irrigation have been employed. The simple gravity system was the first; in many cases, however, the contour of the land made it necessary to adopt low-head pumping in order to reach elevations lying slightly above the gravity ditches. But in any ditch system the losses of water by evaporation and seepage are serious. The sinking of wells has been tried with very satisfactory results, and the water supply obtained in this way is frequently superior to ditch water. The author described at considerable length the methods of well drilling. Motor-driven centrifugal pumps are quite generally used. The transformer ratings for this service range from 1000 watts to 1200 watts per hp of motor rating, on account of the necessity of continuous operation for weeks at a time. The average farmer in irrigation districts is regarded as a very reliable customer. Cost comparisons given in the paper indicate that water pumped from wells costs about one-half as much as gravity water from ditches.

A brief description was included of the steam generating station of the Northern Colorado Power Company, which supplies energy for a territory covering about 3000 square miles. Energy is transmitted over a line 120 miles long at 44,000 volts and delivered to substations 20 miles apart, where the potential is reduced to 6600 and 2300 volts for distribution. Two forms of rate schedules were described and copies of consumers' contract forms were presented in an appendix. The modern principles in cattle feeding were described in some detail, including mention of the numerous uses of motor service for grinding and mixing feed and for cutting ensilage. Electric cuffers or vacuum cattle cleaners are also in use on many dairy farms, because modern methods of dairy sanitation compel their adoption. Motor-driven vacuum milking machines are also coming into use, and numerous other uses for small motor drives are rapidly developing.

Discussion.

In the absence of the author, the paper was read by Mr. A. W. Hahn, of Denver, who also exhibited numerous lantern slides and motion pictures showing, with many touches of human interest, the various steps in securing water supply for the irrigation of the arid farm lands in northern Colorado. Great interest was manifested in this paper, and many questions were asked by Mr. Hahn regarding the novel practices of his company in securing this class of business. The discussion was participated in by Messrs. J. A. Britton, San Francisco; Samuel Insull, Chicago; J. E. Davidson, Portland; H. L. Doherty, New York; P. Junkersfeld, Chicago; J. C. Hayes, Los Angeles; H. R. Kingman, Portland, and R. H. Ballard, Los Angeles.

Mr. Britton described in a very interesting manner the experiences of the Pacific Gas & Electric Company in developing irrigation pumping and promoting the uses for electric energy on the farm in California. This company has a connected motor load of about 25,000 hp in irrigation service. The average farmer consumer pays the company a revenue of about $115 a year. The State of California does a great deal for the assistance of the farmers and during six months of the year sends out, through the courtesy of the Southern Pacific Company, a special train which tours the State and carries literature and agricultural information to the farming communities. The Pacific Gas & Electric Company has, at its own expense, added a car to this train showing the various uses for motor drives on the farm, as well as miscellaneous applications of electric energy. The rates for motor service for irrigation are $10 a year per connected horse-power, and a sliding scale for energy consumption ranging from 3 cents down to 1.5 cents per kw-hr.

Mr. Insull observed that one of the most beneficial results of holding the present convention in the West has been the demonstration to visiting central-station men of uses and advantages of electric irrigation. This subject, he said, has also tremendous applications in the Central West. The irrigation demand comes during the summer months when much of the central station's equipment is lying idle and is one of the numerous applications of electricity on the farm for which the small companies' electrical equipment can be drawn upon to mutual advantage.

Mr. Davidson said that in the Yakima Valley, with an annual rainfall of 6 in., the Pacific Light & Power Corporation has 250 irrigation plants ranging from 2 hp to 900 hp in size. Service is furnished on both meter and flat rates, the irrigation season being from April 1 to Oct. 1. Under the flat rate, $30 to $42 is charged per horse-power for the season. Under the meter schedule, the rate is $12 per hp-year for all connected load and an energy charge of 3 cents to ½ cent per kw-hr.

Mr. Doherty pointed out that there are many hydroelectric plants for whose output there is yet small market, and that in such cases the development of irrigation load is practically a necessity. In many hydroelectric projects irrigation systems can be combined to the mutual advantage of both plants. The depth from which it is economical to pump water for irrigation purposes depends, of course, on the value of the land and the crop raised. For land worth $600 per acre, for example, water can be economically pumped from the "bowels of the earth." In the West water is often worth more for irrigation than for hydroelectric development. In one case cited by Mr. Doherty the irrigation value was ten times the hydroelectric development value, and it therefore became most economical to install a steam plant.

Mr. Hayes said that 90 per cent of the energy produced by the Mount Whitney Power Company is now used for the pumping of water, the system load-factor being 50 per cent. Extensions are made on a basis of a mile for 6 hp of prospective load. Customers pay on a flat-rate demand system, the schedule being $50 per hp-year. Many of the installations are those of comparatively small customers. Water is pumped from a depth of from 15 ft. to 750 ft., and as a result of irrigation the value of the land has increased from $25 to from $150 to $500 per acre.

Mr. Kingman recommended the use of belt-driven outfits on account of the ease of changing the motor and moving

it about. Electric irrigation has also been actually found to accelerate the growth of crops, since the water delivered from wells at a temperature of 75 deg. advances the date of maturity by thirty days over that obtained by irrigation with cold ditch water.

Mr. Ballard said that the use of irrigation has had remarkable effect on the load of his companies, raising the income to $20 per hp-year of connected load. While there is some gasoline-engine competition, these machines usually break down sooner or later and thereby eliminate themselves. Some are bought up by the local company and shipped out of the district.

In closing the discussion Mr. Hahn said that the North Colorado company does not sell but only recommends to the farmers the equipment they should have and sees to it that they get a square deal from the supply men. The greater part of the pumping plants are specially designed for each installation. It has been found possible to irrigate 320 acres from one well, delivering 200 in. of water per year over the entire area. In the Northern Colorado district warm water is found undesirable, on account of the greater rapidity with which blight increases when it is used.

ELECTRIC IRRIGATION SERVICE.

An informal discussion of electric irrigation was held by about fifty delegates as a result of the interest expressed in the subject at the opening transmission session. Mr. Lewis A. McArthur, Portland, presided. Mr. John C. Hays, Visalia, Cal., described the development of electric irrigation on the system of the Mount Whitney Power Company, which has been handling this class of business for thirteen years and which has a connected pumping load of about 8000 hp. The most popular contract is one based upon a flat rate of $50 per hp per year. The flat rates are popularized without great difficulty. A meter rate is also used in handling the smaller work, and a third form of contract is based on a combined flat and meter rate amounting to about $31 per hp-year. The season runs from February to August. The largest motor on the system is rated at 75 hp, the average motor rating being 7.5 hp. Mr. Hays thought that in some cases service is sold at too low a rate. Extremely low prices are not necessary to encourage irrigation service. The maximum lift is about 460 ft. At the Mount Whitney rates about five acres of orange-growing land are irrigated per hp, so that the electric-service cost is $10 per acre per year—a nominal sum in relation to the cost of the land, which is about $200 an acre.

The company serves about seven towns, constituting a "straight agricultural" region. Ninety per cent of the output is used in pumping water. The lighting peaks are of short duration. The irrigation load is practically continuous during the season. Measurements are made on the secondary sides of the transformers except in cases where a large ranch operates a group of motors on a meter rate. The average plant costs in the vicinity of from $1,000 to $1,200. The casings of wells are from 8 in. to 12 in. in diameter, as a rule.

The prices of drilling the casings range from $1.75 to $2.50 per foot, according to Mr. A. E. Wishon, Bakersfield, Cal. Effective solicitation is accomplished by taking prospective customers to users of service. The best results are gained by spreading the irrigation service over a long period. Knowledge of farming is of great importance, and if the solicitor looks like a ranchman the results are better. The cost of building a mile of line is about $650. The pumping plants have an efficiency of about 50 per cent. The San Joaquin company does the electrical installation work. Instalment payments are used to some extent. An integrating meter is placed on all motors for checking service requirements. A monthly inspection of installations is made. The second-hand gasoline engines are disposed of through an agency.

Mr. C. W. PenDell, Chicago, said that a double-throw switch permitting only a part of the motor equipment to be operated at once is a useful device in pumping service. The Public Service Company of Northern Illinois has a cancellation clause in its contract stating that 20 per cent of the amounts formerly paid is required to liquidate damages. In all pumps of 5 hp and over a double-acting cylinder is required, with flywheels heavy enough to avoid voltage fluctuations. Some trouble has been experienced with turbine pumps running at 1750 r.p.m. A serious vibration occurs as the speed rises. At 1120 r.p.m. little vibration occurs, and this maximum speed is now urged by the company. The total distribution loss in the pumping district is sometimes as high as 35 per cent. As in California, the electric company insists on the apparatus meeting full specifications, holding manufacturers responsible for their equipment.

In reply to questions, Mr. Hays said that the maximum demand measurements are taken on a few minutes' load basis. In case of a default, after due notice, the company discontinues the supply of energy and cancels the contract. A monthly non-contract rate is in use. The deep-well pumps are mainly of the single-acting type. The average depth of wells is from 150 ft. to 200 ft., the water level going to within 60 ft. or 70 ft. of the surface. Centrifugal pumps require good regulation of voltage. The main feeders are estimated on a 5 or 6 per cent drop, while in the sublines to motors they are of large cross-section for mechanical reasons. Wiring is done practically at cost. A 50-in. well is about as large as is desirable. The maximum head on the centrifugal pumps seldom exceeds 50 ft. Mr. H. S. Wells, Pacific Power & Light Company, Portland, Ore., said that no contracts are taken without a lien upon the farmer's land and installation.

Mr. H. W. Soderling, Wenatchee, Wash., stated that he takes a lien upon every installation. The lien is regarded as an asset by loan companies. The company plans to have its investment returned in not more than three years from the income obtained. All energy is supplied and measured at 2200 volts, and the ranchman purchases all equipment. Any gasoline engine that has been run for five years is a pile of junk if it has not had practically its initial cost spent upon it. At least 20 per cent depreciation applies to gasoline engines. The reliability of electric service is far greater. Continuous service with a gasoline plant "requires a mattress in the pump house." If a man loses his well, a temporary abatement of his contract is given. The rate charged on a six months' basis is $7.20 per hp-month, with a maximum discount of 20 per cent. In some ten-year contracts the amount of required service is reduced during the earlier years while the property is developing, although the hp-rate is not altered.

Mr. E. B. Walthal, Fresno, Cal., said that the highest load during the year totals 80 per cent of the ratings of all the motors connected. He questioned, as did Mr. Wishon, the legal value of a lien clause. Chairman McArthur emphasized the moral effect of a lien as a deterrent of irregularities. Mr. A. W. Hahn, Denver, said that the Northern Colorado Power Company makes no use of a lien. Use of service is encouraged every month in the year in Wenatchee. As a rule, the 5-hp unit is the largest squirrel-cage motor permitted. Mr. PenDell severely criticised the use of iron wire in lines connecting feeders with motor installations. He considered curve-drawing meters undesirable for the measurement of maximum demand. The printing meter showing total kilowatt-hours every thirty minutes appears to be the most available method, although there is room for improvement. An independent clock is desirable to separate the stamping from the tape-driving mechanism.

Mr. D. F. McGee, Pacific Power & Light Company, Portland, Ore., stated that galvanized-iron wire is satisfactory for distribution at 6600 volts. Copper-clad steel wire is also useful, permitting spans as high as 300 ft. Economy in line construction is highly desirable where the business is seasonal and of short duration.

ENERGY-CONSUMING DEVICES.

A paper presented by Mr. F. N. Jewett on new energy-consuming devices dealt with single-phase converters and rectifiers adapted to charging electric-vehicle batteries and for miscellaneous other uses, such as moving-picture and theatrical work, operating telegraph systems and railway signals, etc. The devices of this class considered by the paper were limited to an output of 5 kw or less. This apparatus has been developed by one of the well-known large manufacturers. The single-phase synchronous converter resembles in its outward appearance the single-phase commutator type of motors built by the same manufacturer. Among the unique features are the unusual proportions of the windings and the use of a short-circuited winding in the stator to prevent hunting. It may be started with equal facility from the alternating-current or the direct-current side. Voltage regulation is facilitated by means of a special transformer on the alternating-current side, which is provided with numerous taps. For charging very small storage batteries, such as those employed for automobile and motor-boat ignition and lighting, the manufacturer has developed a single-phase mechanical rectifier.

Discussion.

Numerous questions were asked of the author of this paper in reference to the characteristics of the equipment described. Those participating in the discussion were Messrs. F. M. Tait, Dayton, Ohio; Farley Osgood, Newark, N. J.; J. C. Naylor, Portland, Ore., and C. J. Wilson, San Francisco, Cal. The mechanical rectifier was designed to operate on 60 cycles, but it is the intention to place on the market in a short time an improved type which will operate at any frequency from 25 to 60 cycles and at pressures up to 120 volts. No automatic cut-out device for opening the circuit when the storage battery becomes fully charged is provided, because it was the desire to keep the cost of the equipment as low as possible. Such a device can be added, however, at an increase in cost of 50 per cent. There is little danger in using the rectifier without such a device because a charge lasting over night or even for twenty-four hours will rarely do any damage. The efficiency of this equipment is about 50 per cent and is rather high considering the small capacity. The retail price is approximately $25. It was brought out that the rectifier delivers only half-waves to the direct-current side and therefore furnishes an interrupted current. In a new type to be brought out there will be two interrupters embodied in one mechanism, using both sets of half-waves.

TWENTY-FOUR-HOUR SERVICE.

The paper on twenty-four-hour service in small central stations, prepared by Mr. Taliaferro Milton, dealt in the main with the possibilities resulting from the use of storage batteries. Such use was considered under three heads: First, in new plants where a sufficient number of profitable customers cannot be obtained without giving a twenty-four-hour service, which would be prohibitive if it were necessary to operate the generating plant continuously; second, in existing plants where the inauguration of a twenty-four-hour service would secure additional customers and sufficient yearly revenue; third, in plants like the last where the inauguration of a twenty-four-hour service will so improve the quality of service that the increased returns will more than offset the charges on the additional investment before the elapse of a considerable period. A number of examples were cited where storage batteries have been successfully employed in small direct-current plants. Among those mentioned were the New Windsor Electric Light & Water Company, New Windsor, Md.; the Jordan Electric Light Company, Jordan, Minn.; the Chester Electric Light Company, Chester, Mass., and several others.

Discussion.

Owing to the absence of the author, the paper was read by Mr. G. R. Murphy, San Francisco, Cal. Considerable interest was manifested in the subject. The discussion was participated in by Messrs. J. B. Crane, Duluth, Minn.; P. H. Korst, Janesville, Wis.; G. H. Atkin, Chicago; J. C. Naylor, Newark, N. J.; G. R. Murphy, San Francisco, Cal.; J. W. Cowles, Boston; J. A. Lighthipe, Los Angeles, Cal., and E. Baughn, North Yakima, Wash. The statement presented by the author that an annual charge of 15 per cent on the first cost of storage batteries is sufficient to cover interest, depreciation, maintenance, insurances and taxes was questioned by several. It was pointed out, however, that while the depreciation of the positive plates may be rapid, their cost is only a fraction of the whole cost of the battery. The general policy of employing small batteries to give continuous or twenty-four-hour service in small central-station systems, necessarily involving the use of the direct-current system of distribution, was questioned by a number of those discussing the paper. One of the speakers stated that it is preferable, as a matter of general policy, to install the standard alternating-current system, in order not to be hampered when the plant expands in the future or when it becomes desirable to interconnect it with some other system.

It was brought out in the discussion that the question of battery depreciation may be serious under unfavorable conditions, but even with good attendance the life of the plates is not likely to exceed ten years. Another speaker pointed out, however, that when properly maintained the life of the battery is very closely determined by the load, inasmuch as the plates have a definite total life in ampere-hours. Another speaker described his experience with a 150-kw plant which he has been operating for a year. Almost immediately after he assumed charge twenty-four-hour service was inaugurated, with the result that now the number of customers is practically double what it was a year ago. This plant, however, is operated with water-power and employs a 10-mile transmission system so that the use of storage batteries is impracticable. It was also brought out that in gathering statistics on the cost of battery maintenance it is essential to find cases where the experience extends over a period of at least ten years, since the maintenance charges will be small, naturally, until it becomes necessary to renew some of the plates. It seemed to be the consensus of opinion, however, that the inauguration of twenty-four-hour service, even though at first for only one day a week, quickly results in a substantial increase in business. It is, as a rule, easier for water-power plants to commence giving twenty-four-hour service than for steam-driven plants, since the latter must make fuel.

MUNICIPAL WATER PUMPING.

In a paper by Mr. Charles A. Munroe on the desirability of municipal pumping for water-works as a central-station load it was pointed out that a population of more than 40,000,000 in this country is furnished from municipally owned water-works, the author stating that at the average price of 2 cents per kw-hr. gross earnings of about $14,880,000 per year would be yielded to central stations if the load were handled electrically. About 744,000,000 kw-hr would be needed, on the basis of 40 gal. per capita per day. The average energy required to handle 1000 gal. is 1.5 kw-hr. The off-peak characteristics of the pumping load were touched upon, and the benefits of the small space required by the electric drive were reviewed. In addition to automatic features in operation the load can be dropped during the station peak without inconvenience to the town. The paper recommended the use of a surface reservoir in addition to a standpipe in larger municipalities, where water is pumped from deep wells, in order to decrease the head against which the deep-well pump has to operate and to give a large supply of water on the surface in case of fire. The making of contracts on a kilowatt-hour basis was advocated on the ground that contracts on a flat rate per 1000 gal.

pumped tend to throw the cost of pumping-machinery repairs on the central station, render the latter responsible for the successful running of pumps in case of fire, and introduce complications in case the wells give out. In many municipal pumping plants the attendance charge is high and practically equal to the kilowatt-hour charge by the central station. Electric pumping almost always saves the municipality substantial sums of money and if handled without being hampered by political influence and at an early date is a desirable business.

REFRIGERATION, VENTILATION AND LAUNDRY MACHINERY.

The report of the committee on refrigeration, ventilation and laundry machinery, submitted by Chairman John W. Meyer, comprised four separate papers, dealing respectively with refrigeration, ice-making, ventilation and laundries. The paper on refrigeration, compiled with the assistance of Mr. R. L. Lloyd, showed ten annual load curves in typical refrigeration plants, with data and illustrations covering about twenty representative installations in various cities. One of the essential things in securing this sort of load for the central station is a clear understanding of the fundamental principles and operations in refrigeration. The usual ton rating of refrigerating machines means a heat-extracting capacity equal to 284,000 heat units per day, or 11,833 units per hour. One simple method of estimating the required rating is to find the ice consumption from previous experience, but in the case of new installations a theoretical calculation must be made, an example of which was worked out. A partial list of refrigerating and ice-machine manufacturers was presented and also a list of industries using motor-driven refrigeration plants, showing sizes of motors, energy consumption, tons of refrigeration delivered and other data.

The paper on ice making showed a total of 2004 plants in the whole country, with an average of 158 hp per plant. Most of these plants are of the absorption type. There are known to be 146 central stations operating ice plants, with an average rating of 13.6 tons, nearly all reporting satisfactory results. A list of these plants was given, with the tonnage, days of operation per year and average output per summer day of each. Detailed data were presented on a Baltimore plant, on another described very fully in a paper by Mr. A. C. Smith, of the Cataract Power & Conduit Company, and on several smaller installations. The subject of ventilation was covered in a general way in a brief contribution by Mr. Carl F. Scott, which referred to a few of the motor-driven installations in large modern hotels.

The section on laundries consisted mainly of a paper by Mr. John Richmond, of the American Laundry Company, on the use of motor drives and the general conditions as regards the use of electric energy for various laundry requirements. The problem of the laundry is not one of mechanical power but one of heating; the former is a by-product from the latter. By adding motor-driven machines and electric heating devices, operated from an isolated plant, it is possible to make the exhaust steam just meet the heating requirements, but otherwise it would be necessary to use live steam in greater quantities and at increased total cost. Central-station service for sign lighting, interior lighting, overtime motor service and general standby or emergencies is very useful and distinctly necessary. According to Mr. Richmond's statement there are no laundries of substantial size operating wholly on central-station service, and no laundry of average size or above can afford to do so. The committee did not analyze Mr. Richmond's paper, but left it for discussion in the convention sessions or through the Question Box in the monthly *Bulletin*. Miscellaneous data were appended on a number of electrically operated laundries, including motor ratings, energy consumption, monthly cost of operation and the power required to drive various types and makes of laundry machines.

Discussion.

In discussing the report of the committee on refrigeration, which was read by Mr. C. A. Graves, Brooklyn, N. Y., in the absence of Chairman J. W. Meyer, Mr. I. A. Lundgaard, Rochester, N. Y., pointed out that moisture in the air must always be included in estimating the power required for refrigeration, and advised making individual tests in each case. Mr. E. W. Lloyd stated that 600 tons of ice is being produced daily in Chicago by motor-driven compressors. These are all new installations, and the first year has been obviously devoted to experimentation, but valuable data will soon be ready. One plant produces a ton of ice on 60 kw-hr. in summer and on 42 kw-hr. in winter and operates at a load-factor of from 60 to 70 per cent. In a large city like Chicago it is found most economical to install small 100-ton ice factories at intervals of a mile or so, on account of the saving in hauling, etc. Under the Chicago off-peak schedule large consumers obtain energy at 1 cent per kw-hr. The feasibility of raw-water ice-making is still being experimented upon. Mr. R. H. Tillman, Baltimore, Md., reported that ice-making plants operate at good load-factors. The small ice-machine load is increasing rapidly, he said, and offers a very desirable business.

RESIDENCE BUSINESS.

The committee on residence business presented, through Mr. J. F. Becker, chairman, a ninety-two page report covering residence business in the most thorough manner. Replies were summarized from about 260 central stations in cities of varied population, covering answers to over fifty questions bearing upon residence service. Statistics gathered showed that nearly all residences wired are using electricity. Great variations are indicated in the percentages of residences wired to the total number in each community. In Los Angeles, Cal., 100 per cent of the wired houses use electricity and 94 per cent of the residences in the city are consumers of such service. A large amount of use is indicated from reports drawn from cities in the Middle West. All companies reporting stated that fair rates, good service and a liberal policy, combined with vigorous advertising and canvassing, are important means of encouraging new business. The instalment plan of house wiring is generally successful.

A majority of the companies answering the committee's inquiries employ special men for getting residence business, maintain showrooms, carry on demonstrations and encourage special wiring propositions. Set salaries to solicitors are general, although in many cases commissions are included in the compensation. The report points out that much is being done in the way of securing data in the form of surveys of residence loads and possibilities. Tungsten lamps are being widely used for long-hour service, but even so, lighting bills tend to increase as consumers realize the benefits of electricity. Free renewals of tungsten lamps are not given. A large number of reports of revenue from various classes of houses show bills ranging from $1.63 to $4.50 per month. New business seems to be gained almost equally well by special solicitation and by special inducements. Newspaper advertising appears to be most highly favored, with circularizing a close second. Wide variations are apparent in the methods of figuring demand rates. The use of electrically operated household devices is growing by leaps and bounds. Service connection charges are usually nominal within a reasonable distance of the mains. No uniformity appears among residential load factors, which range from 6 to 53 per cent in the replies received. The average cost of reading and testing meters, including repairs, rendering and collecting, seldom exceeds $6 per year.

Among the successful new methods of selling appliances taken up during the past year by the companies replying are a monthly payment plan on toasters, flatirons and elec-

tric grills; a bombardment of fan motor literature in the spring and early summer and the inauguration of an "electric" house exhibit. On the whole, companies do not attempt to make more than nominal profits in the sale of energy-consuming devices. The free-trial method has been widely successful. National magazine advertising of appliances is doing much to induce direct sales of such goods. Little interest appears to have been awakened as yet in electric fireless cookers, probably because the majority of companies reporting are not convinced that a thoroughly practicable device has been evolved.

A large part of the report was devoted to the experience of central-station organizations in Boston, New York, Philadelphia, Denver, Los Angeles, Baltimore, Newark and Brooklyn in securing residence business. Co-operation with builders, real-estate firms and contractors is important. The installation of porch lamps in new apartments, use of key tags with electric lighting advertised on one side, prompt supplying of service, consultation with architects by a specialized employee devoting his entire time to such work, offering a commission to builders on the basis of 25 cents per lamp installed in new houses within two years of completion, wiring on the instalment plan and division of the cost between owner and tenant in difficult cases are all successful methods. Among the new electrical devices for household use which the companies have introduced during the past year are the electric radiant grill, for table cooking; domestic-size heating pad, two-lamp luminous radiator, small-type electric ranges and ovens, deep-type sauté pan, portable motor table and home glue heater. In the concluding portion of the report were included brief discussions of flat-rate residence lighting with the "excess indicator" and of the "Stannos" wiring system, used extensively in Europe.

Discussion.

The report was discussed by Messrs. C. N. Stannard, Denver; R. B. Mateer, Denver; E. H. Mulligan, Pasadena, Cal.; M. C. Osborn, Spokane; Douglass Burnett, Baltimore; L. H. Newbert, San Francisco; Philip Dodd, Cleveland; J. C. McQuiston, Pittsburgh, and J. G. Learned, Chicago. Mr. Stannard remarked that while the majority of houses in the East are piped for gas, by far the greater proportion of Western buildings are wired when new for electricity, so that the necessity for soliciting house-wiring business is less acute in the West than in the East. Electric heating appliances, he added, are used extensively in Denver, one residence, for example, containing twenty-one different devices. Mr. Mateer pointed out that where a charge is made for installing the customer's service loop the fact that an investment has been made leads him to keep service under conditions when he might otherwise desire to discontinue. Mr. Mulligan said that in local competition between central stations and the dealers the company has maintained its prices in the face of undercutting by the supply men, and now finds that they have returned to its scale of rates. Mr. Osborn cited the large number of residence customers in Spokane, which has 14,000 out of a total of 19,000 consumers. The company recently completed a house-wiring campaign directed at unwired premises on its present lines. The work is done by the contractors, with whom the central-station management has kept in close touch.

Mr. Burnett remarked that since the great fire of 1904 the number of customers in Baltimore has increased from 4000 to 25,000. Gas service was formerly well intrenched in the Maryland city, and the innovation of electricity really required a change in the habits of the people. An active sales force was therefore employed, and in the company's offices every comfort and attractive convenience is afforded to get people acquainted with it, its purposes and service. From the recent house-wiring campaign, in which 3000 orders were taken, it was found that the cost of wiring was about 8 cents per watt of connected lamps, while, in turn, about 1 watt is required per square foot of area. This makes possible a rough estimate of the cost of wiring on the basis of floor area alone, and customers calling up the office for a round figure need be asked simply to furnish the number of square feet in their building or premises. Finding it impossible to get fair prices from the local contractors, the central station has been forced to maintain its own wiring department of 100 men.

Mr. Newbert said that while the better classes of houses are invariably wired without solicitation, his company recently started a campaign to reach the smaller houses, equipping its solicitors with insurance maps showing all premises not reached by the company's lines. As a result, a large number of additional contracts were secured. Mr. Dodd suggested that the association, or some other electrical organization, put an impartial man into the field to adjust local differences between the contractors and companies by suggestion of methods that have succeeded in other cities. Mr. Dodd also proposed that the association name a committee of five to meet with the contractors and jobbers, to discuss such differences in local situations. Mr. Mulligan suggested that architects' organizations be included in such meetings. A feature of the session following the discussion was the presentation of a moving-picture drama entitled "The Electrical Education of Mr. and Mrs. Thrifty," depicting the difficulties experienced by a young couple with obsolete cooking and household equipment, followed by their complete happiness with an electrically fitted household. These pictures were prepared by the Westinghouse Electric & Manufacturing Company, and Mr. McQuiston explained that they would be loaned to any central station desiring to make local exhibitions.

ELECTRIC VEHICLES.

The committee on electric vehicles, through Mr. L. R. Wallis, chairman, submitted an analysis of the electric-vehicle practice of sixty-seven central stations responding to a set of inquiries bearing upon the commercial side of the industry. Of the companies reporting, forty-nine use electric vehicles in their own service, owning 73 passenger and 371 commercial machines. The returns indicate that electric vehicles can be used to advantage even in hilly sections, as in some cases more vehicles of this type are used in hilly municipalities than in others of equal population where the roads are level. In the territory served by the eighteen stations using no electric vehicles of their own, there are 648 such vehicles in use by the public. This indicates that in some cases the public has a better appreciation of the benefits of electric vehicles than have the central stations themselves. Within the territory represented by the report are 11,044 passenger and 2619 commercial electric vehicles aside from those in use by central stations. The committee considers this a creditable showing, but urges the more extended development of this branch of the industry in view of the great possibilities. In the territory reported on there are 421 public charging stations. Twenty-three companies make off-peak rates, but only twenty-five companies provide charging facilities.

The public garages receive rates from the central stations of from 10 cents to 2 cents per kw-hr., depending upon local conditions and consumption of energy. The rates offered for private charging are 1 cent or 2 cents higher on account of the decreased consumption. In regard to advertising, twenty-seven companies employ newspaper space or issue circulars or electric-vehicle literature. In answer to the request for suggestions as to the best methods of popularizing electric vehicles eight companies suggested a reduction in the cost of the vehicles themselves, eight advised advertising, two suggested a lower rate for energy, one advocated an off-peak rate, four suggested the establishment of an electric-vehicle department, four the use of electric vehicles by the central stations

themselves, with an offer to loan them for demonstrations; five favored co-operation with the manufacturers, ten the education of the public, and three getting manufacturers to establish agencies. Other suggestions were educational campaigns, improved rates, personal solicitation of prospective customers, commissions to agents on cars sold and the installation of public charging stations in convenient places. The committee recommended placing at least one person in charge of electric-vehicle exploitation in each central-station organization, urged closer co-operation with agents of manufacturers, impartial treatment of competitive makes of vehicles, the extension of public charging stations and intelligent use of publicity of various sorts. Emphasis was laid in closing upon the great value of battery charging in filling the valleys of the station load curve without the installation of new generating equipment.

Discussion.

Mr. R. B. Mateer, Denver, Col., related that his city, with a population of 213,000, now has 800 pleasure vehicles and thirty trucks. All equipment is maintained under the supervision and advice of an expert engineer who devotes his time, free of charge, to customers' machines and batteries. The Denver company also issues a magazine which is distributed among present vehicle users and good prospective purchasers. The vehicle-charging load at Denver now amounts to 2,000,000 kw-hr. per annum. Mr. Hamilton, Newark, N. J., deplored the tone of criticism in the report concerning the alleged indifference of central stations in co-operating with manufacturers of electric vehicles. The "unloading" of cars on to the central station, to be in turn unloaded on to the public, is not, he said, the way to sell electric vehicles. Mr. Hamilton described the expensive methods and outlays for advertising made by his company in co-operating with vehicle manufacturers.

Mr. J. P. McSweeney, Rochester, N. Y., told of the economy discovered in delivering milk with electric vehicles covering carefully routed territories, as compared with the wasteful methods of half a dozen milkmen covering the same territory with horse-drawn wagons. Mr. William H. Blood, Jr., Boston, Mass., president of the American Electric Vehicle Association, said that the cost of energy is as little considered by the operator of an electric vehicle as is gasoline in the case of the gas car. Although the days of experiment with electric trucks are now past, the public still holds against the battery-driven car its early shortcomings in the days of improperly built models, and this prejudice must be eradicated before electric-truck service can be developed to its deserved extent. Electric trucks should be recommended only for the uses to which they apply, and they are not fitted for very short city hauls or long-distance cross-country work. At the present time, said Mr. Blood, the American Vehicle Association is spending $50,000 in an advertising campaign in the principal trade and general magazines, looking toward a general increase in the use of electric vehicles without respect to individual makes.

Mr. F. J. Bird, Indianapolis, Ind., urged that lighting companies exercise the strictest impartiality in the purchase of cars for their own use as well as in the forwarding of tips on prospective purchasers. In answer to a question from Mr. C. W. PenDell, Chicago, Ill., Mr. Mateer said that about 60 per cent of Denver users do not consume their minimum of $5 a month for private garage rectifier connection. Mr. B. F. Ott, Franklin, Pa., reported that in his own little city of 10,000 use is made of twenty-four pleasure vehicles and several trucks.

ELECTRICITY IN RURAL DISTRICTS.

The committee on electricity in rural districts, Mr. John G. Learned chairman, submitted a fifty-eight-page report. It covered a brief outline of progress since the last convention, gave a large number of valuable data upon the cost and energy consumption of electrically driven farming equipment, reviewed the benefits of electrically operated irrigation systems, and besides describing an extensive installation of farming motors in Illinois, concluded with an exhaustive bibliography of the general subject of electricity in agriculture.

The results of a large number of tests made under the auspices of the General Electric Company were presented in the report in detail and in a tabular summary. The tests were unusually complete in giving full particulars of the connected load in practically every instance, character and amount of material handled, mechanical conditions of machine driving, labor costs, fixed charges, energy consumption, maximum and average loads, total and unit costs. All operating costs were figured on the basis of an energy rate of 5 cents per kw-hr. Interest charges were figured at 6 per cent and depreciation at 10 per cent. The principal unit costs determined by the tests were as follows:

Grinding corn, 0.41 kw-hr. per bushel, 150 hours per year. Energy cost, 2.05 cents; interest and depreciation, 15-hp motor-driven grinding mill and belting, 1.2 cents; labor, 0.75 cent; total, 4 cents per bushel. Total yearly saving by electricity, as compared with hauling corn to mill 2 miles away, $180.

Shredding and husking corn, 5.37 kw-hr. per ton, 15-hp motor, six-roll shredder and husker. Costs not figured in detail.

Threshing 1750 bushels barley with gasoline tractor, used forty days per year, 1.1 cents per bushel, including all charges. With electricity the same work was done, including all costs, at an expense of 0.7 cent per bushel. The saving would have been larger if a larger volume of work had been handled. Only 1750 bushels were threshed in each case.

Electric "Home Laundry" machine, driven by 0.25-hp motor. Energy consumption per washerful, 0.061 kw-hr.

Family-size washing machine, run 260 hours per year. Total cost per washerful, energy, 0.3 cent; interest and depreciation, 3.4 cents; labor, 0.83 cent; total, 4.54 cents.

Portable vacuum cleaner, driven 260 hours per year by 0.25-hp motor. Kw-hr. to clean 100 sq. ft. of rugs, 0.0226; cost of operation, energy, per 100 sq. ft., 0.115 cent; interest and depreciation, 0.96 cent; labor, 1 cent; total cost per 100 sq. ft., 2.07 cents.

Sweeper vacuum cleaner driven by 3-hp motor, test upon floors in fourteen-room house. Average vacuum, 10 in.; energy consumption per 100 sq. ft., 0.107; energy cost per 100 sq. ft., 0.54 cent; interest and depreciation, 8.4 cents (first cost was $1,365); labor, 0.6 cent; total cost per 100 sq. ft., large and highly efficient machine, 9.54 cents. Machine was used 156 hours per year.

Horse groomer, driven 328.5 hours per year by 1-hp motor. Energy consumption, 0.106 kw-hr. per horse; labor cost, 2.25 cents per horse; energy cost, 0.53 cent; interest and depreciation, 0.55 cent; total cost, 3.33 cents per horse groomed.

Cream separator, driven 183 hours per year by 1.5-hp motor. Machine cost $350; energy cost per 100 lb. separated, at 0.0386 kw-hr. per 100 lb., 0.19 cent; interest and depreciation, 2.36 cents; labor, 0.29 cent; total cost, 2.84 cents.

Butter churn and butter worker, driven by 2-hp motor. Initial cost, $118.50; energy requirements, 0.00617 kw-hr. per pound of butter; hours used per year, 88; costs per pound of butter, energy consumption, 0.03 cent; interest and depreciation, 0.126 cent; labor, 0.087 cent; total, 0.244 cent.

Sausage grinder, operated eighty hours by 4-hp motor. Energy consumption, 0.441 kw-hr. per 100 lb.; cost, 2.2 cents; interest and depreciation, 5.8 cents; labor, 2 cents; total, 10 cents per 100 lb. This test showed that the machine was too large for ordinary use and would be operated at maximum economy only when run on heavy and sustained outputs.

Sausage stuffer. Average horse-power required, 0.37; time operated, 517 hours, stuffing 60,000 lb. sausage; energy cost, 0.0525 kw-hr. per 100 lb., 0.26 cent; interest and depreciation, 11.5 cents; labor, 25.9 cents; total cost per 100 lb., 37.66 cents, including all operations.

Root cutter, driven 52 hours, cutting 300 tons beets and turnips. Motor rating, 2 hp; machine energy requirements, 0.158 kw-hr. per ton; cost of running, energy, 0.79 cent; interest and depreciation, 5.99 cents; labor, 5.2 cents; total, 11.98 cents per ton.

Rolling oats, in 25-hp grist mill, machine used 360 hours per year. Costs, energy at 0.062 kw-hr. per bushel, 0.31 cent; interest and depreciation, 0.297 cent; labor, 0.27 cent; total, 0.877 cent per bushel. Machine too large for average farm.

Other costs given were: Cracking corn, operating 120 hours per year, 0.107 kw-hr. per bushel, total cost, 1.37 cents per bushel; grinding shelled corn, 2.48 cents per bushel (energy consumption, 0.272 kw-hr. per bushel); shelling corn, 1.37 cents per bushel; cutting fodder, 3.97 cents per ton.

Discussion.

Mr. R. B. Mateer, Denver, Col., reported a new farm application in the form of a reliable milking machine operated by a single-phase, 220-volt motor, the income from which is $6.50 per month. A large amount of energy is used for irrigation, the income per season averaging $2.65 per acre. Mr. C. W. PenDell called attention to Mr. C. H. Williams' paper on irrigation, read at the first transmission session. Mr. E. L. Callahan, Chicago, Ill., declared that while it is expensive for central stations to build lines to reach isolated users, the farmer, on the other hand, should not be required to finance such extensions, since the construction should comply with the electric company's specifications and title to the lines should revert to the company sooner or later. Unless there is pumping, thereby assuring long-hour service, farm-load business is usually not very desirable. Where farmers pay for the line it is the practice of the Byllesby companies to charge a minimum of at least $1 per horse-power for motors. Mr. S. V. Walton, San Francisco, said that the Pacific Gas & Electric Company has 25,000 hp in electric pumping units. Extensions are now made to new sections wherever the gross income from the business reached is equal to 10 per cent of the original investment, provided the territory is considered good. Otherwise a higher percentage is required. The company advances the entire cost of the line construction. The average return is now $10 per horse-power per year. All circuits are 11,000-volt, three-phase lines. The cheapest line construction costs $400 a mile, and from this the cost ranges upward to $800 a mile. Contracts are closed on a five-year basis.

Mr. C. W. PenDell, Chicago, Ill., said that for lands producing several thousand dollars a year it is profitable to pump water from almost any distance for irrigation. The North Shore Electric Company's distributing lines are all single-phase, motors no larger than 10 hp being allowed without special permission. Guarantees required are such that the cost of the line, not including transformers, will be returned in three years. A minimum of 50 cents per horse-power per month covers this charge. Mr. M. C. Osborn, Spokane, Wash., said that $65 is allowed for construction of lines the business of which amounts to $20 a year, thus retiring the investment in three years. In mining districts the mine operators defray the cost of the line construction, the company rebating 25 per cent of the monthly bill until the cost of construction is paid.

Mr. J. J. Frey, Hillsboro, Ill., reported that on his own farm-service system individual farmers are charged $125 for connection, with a minimum of $18 a year, and an energy charge of from 15 cents to 10 cents per kw-hr. Meters are read every ninety days. Mr. S. H. Wallace, St. Louis, Mo., said that in developing suburban districts it has been found of advantage to charge real-estate firms and groups of farmers interested in securing service with the actual cost of the line plus overhead charges for interest, depreciation, etc. Unity-power-factor motors have been used with success on these single-phase lines. In closing the discussion Chairman Learned said that the available business in rural districts is not confined to farms and irrigation, but, as pointed out by the committee, includes service to mines, gravel pits, ice-cutting machines, etc.

INCREASING THE MOTOR LOAD.

The importance of increasing the motor load as a means of adding to revenues and improving operating economy, with collateral benefits to the fixed charges per unit of output, was emphasized in a paper by Mr. H. W. Cope. Representative diagrams of the output of a typical lighting plant and the fuel, labor and interest costs were given, showing the excessive burden of fixed charges carried by all stations having pronounced lighting peaks and relatively small motor-service business. The author also showed by curves that electric motor applications are rapidly gaining over steam plants in industrial service, so far as the rate of increase is concerned. The enormous field awaiting central-station service is indicated, however, by the fact that in 1909, the census showed that only 22 per cent of the whole industrial service of the country was furnished by electricity, and of this only 36 per cent, or about 8 per cent of the total power, was supplied by central stations.

The greater part of the paper advocated extending central-station motor-service business by taking up single industries for stated periods, rather than by attempting to establish motor service in miscellaneous fields. In this connection an industrial survey of each central-station community was recommended, with classification of industries into loads of various degrees of desirability. The writer contended that the concentration of solicitors upon a single industry would result in a much deeper knowledge of industrial conditions, and he urged that manufacturing organizations specializing upon specific branches would be able to give better attention and more efficient technical service to propositions involving the larger fields of application than is now possible in connection with scattering efforts to install motors over wide ranges of use. Economy in obtaining data is conserved by specializing for the time being upon a single industry. In conclusion, the writer vigorously urged the more general practice of efficiency engineering by central-station organizations in connection with the analysis of a prospective customer's plant conditions. He advocated the liberal employment of outside specialists in many instances and cited cases in which substantial savings in the unit cost of production had followed the rearrangement of plant and the conversion of establishments to the electric drive. In one case the substitution of the individual motor drive for a mechanical drive in which the arrangement of machines was changed 90 deg. resulted in the installation of 25 per cent more units, intensified production, and reduced the amount of labor necessary for handling material 50 per cent. The total saving in another case where central-station service was installed afforded a return of 19.5 per cent on the investment in individual drive against 4.5 per cent with power generated on the premises. In other words, $12,000 invested in motors, wiring, control and mechanical changes in the machine shop brought greater returns than $24,000 would have brought if invested in power-plant additions, because of the improved facilities for doing work with the decreased time needed for motive-power repairs.

Discussion.

Discussion of Mr. Cope's paper was deferred until after the presentation of the report by the committee on large motor users, which was abstracted by Mr. S. V. Walton,

San Francisco, when both topics were thrown open for a general discussion.

ENERGY FOR WESTERN MOTOR SERVICE.

The report of the committee on selling energy to large motor users of the Rocky Mountain and Pacific Coast states, of which Mr. J. B. Lukes is chairman, summarized the results of practice in the sale of energy to concerns purchasing at least 25,000 kw-hr. per month. Returns were tabulated from twenty-four companies, all of which generate energy on a large scale. A total of 461 large customers was reported. Of these 212 represented installations of less than 200 hp and 108 represented installations of over 500 hp. A table of load-factors for forty-four industrial applications was included in the report, among the better load-factors being the following maxima: Alcohol plants, 90 per cent; breweries, 75 per cent; cement plants, 90 per cent; carbide and soda works, 95 per cent; flour mills, 95 per cent; gold dredgers, 80 per cent; ice plants, 90 per cent; mines, 85 per cent; oil-pumping plants, 80 per cent; paper-manufacturing plants, 90 per cent; street railways, 80 per cent; water-works, 88 per cent.

An analysis of rates in force among the companies replying showed very little uniformity of practice. The range of rates for large motor users is from 3 cents to 0.6 cent per kw-hr., depending on the class of service. Many factors influence the establishment of rates to large motor users, such as the amount of energy consumed either yearly or monthly, load-factor, location of customer, service requirements at specified hours, length of contract, relation to peaks, and customer's demand. About half the companies provide special rates for off-peak business. The report concluded with a discussion of reasons why central-station service is not used, a résumé of the items of expense which must be taken into account in estimating isolated-plant costs, and the problem of financing the work of extending lines to handle new business out of reach of the existing distribution system. The committee expressed the opinion that the question of fixing a rate for a large motor customer is one that requires special attention in each individual case, and that it is not practicable to have a regular established rate unless there is a regular rate for each class of service.

Discussion.

Mr. M. C. Osborn, Spokane, Wash., advocated a common uniform plan of rate-making for sales of energy for motor service and recommended study of the problem by the rate research committee. Mr. R. B. Mateer, Denver, Col., complimented the committee on the completeness of its report. Mr. C. A. Graves, Brooklyn, N. Y., objected that some of the curves contained in Mr. Cope's paper do not contain typical values. Mr. Cope explained that these figures were taken from a paper read before the association in 1908 by Messrs. Bibbons and Robbins.

Mr. W. H. Lines, Portland, Ore., explained that the plan outlined is employed with success by the Portland company, with the exception that certain classes of business are permanently assigned to special salesmen. Motor-service solicitors, said Mr. Lines, too often overlook the greater secondary savings due to motor drive by attention to first economies of operation. Mr. C. W. PenDell, Chicago, called attention to the disadvantages which may result later from motor-service contracts in which central stations agree to do customers' electrical engineering work. In a communication Mr. E. D. Dreyfuss, Pittsburgh, Pa., claimed that the coal prices and cost figures stated in Mr. Cope's paper were exceptionally low and therefore should not be quoted generally.

OZONATORS.

In a paper on ozonators and their exploitation by the central station Mr. M. O. Troy gave a valuable résumé of the history of ozone, touched upon its physiological and hygienic usefulness, quoting various medical authorities, and concluded with a discussion of the practical aspects of the ozonator from the standpoint of the central station. Among the industrial possibilities of the ozonator are the preservation of food products and raw material, displacement of drugs, sugar and sterilization as preservatives by heat, prevention of the growth of parasites in flour storage and wine cellars, use as a bleaching agent and as a factor in the extraction of gold by the cyanide process. Other industrial uses include the aging of rugs and fabrics, manufacture of linoleum and oilcloths, oxidation of paints and linseed oil, and reclamation of rancid butter and fats. An important field is the sterilization of drinking water, and the author cited several large installations in Europe where this service is regularly carried on. Purification of the atmosphere of the home, theater, shop and office also offers striking evidence of the usefulness of ozone.

The paper included brief descriptions of representative ozonators, all of which are electrically operated. The household type of machine requires only 15 watts or 20 watts, but it offers an annual revenue of at least $13 per year at 10 cents per kw-hr., through its long-hour application, and constitutes a load much to be preferred to that offered by many other energy-consuming devices much higher in wattage but which are thrown on the circuit two or three hours a day and perhaps but once or twice a week. In moving-picture theaters it will generally afford a constant load from 10 to 11 a. m. until 11 p. m., and here the larger types of machine find application, their energy consumption running as high as six times that of the household outfit. Loads of at least twelve hours' duration are found in factory applications. Co-operation on the part of local physicians is highly desirable, and it is outside the province of the central station to set forth the therapeutic possibilities of the ozonator. Applications to the general sanitation of the air must be made largely on a trial basis at present, although it is noteworthy that moving-picture houses are now advertising the fact that the air in their auditoriums is in certain instances purified by ozone. From present indications the ozonator should become as popular in the household as the flatiron, percolator, vacuum cleaner, sewing-machine motor and toaster. It is suggested that when a central station has procured a stock of ozonators it advise each of the local physicians that the instruments are on hand, stating their method of operation, their electrical input and their output in ozone, and that they are available for physicians' use. The physician will not expect advice as to what character of disease the ozonator will cure, nor will he expect any instructions from a layman as to how it shall be used on patients.

Lamps and Illumination.

REPORT OF THE LAMP COMMITTEE.

The report of the lamp committee, prepared by Chairman Frank W. Smith, opened with a résumé of the three previous reports, calling attention to the opinion advanced in the 1911 report that the carbon-filament lamp had passed its period of maximum usefulness and was being gradually superseded by the graphitized filament lamp. Statistics presented on lamp sales show that in 1911 the total sales of domestic lamps of all standard types were about 85,000,000, an increase of 8.45 per cent over the previous year. A table was presented showing the distribution of total sales among carbon, graphitized tantalum and tungsten types. The percentage of carbon lamps has been steadily decreasing and in 1911 amounted to 52.9 per cent of the whole. The percentage of graphitized lamps has been gradually increasing and in 1911 reached 19 per cent of the total. The percentage of tungsten lamps has been increas-

ing quite rapidly and in 1911 reached 25.36 per cent of the total sales. Indications point to a further decrease in the output of the carbon lamp, and in 1912 the sales may not exceed 20 per cent. The committee recommends that all member companies, large and small, adopt the graphitized filament lamp as a substitute for the carbon lamp.

Development during the year has resulted in adding substantial mechanical strength to both the drawn-wire and the wire-type tungsten filament. The recent improvements in the 250-watt, 400-watt and 500-watt lamps for from 100 volts to 130 volts have decreased the specific consumption to 1 watt per cp., while preserving a laboratory life of approximately 1000 hours with good maintenance of illumination. In consequence of the improvements to the tungsten-filament lamp it has been possible to standardize the useful life at improved efficiencies. New tables of life, specific power consumption and candle-power were presented.

The committee reported that the use of special tungsten sign lamps has resulted in a considerable stimulus to the electric sign business throughout the country and that the 2.5-watt and 5-watt lamps are coming into use in large numbers. The new types and sizes of lamps announced by the manufacturers since May 1, 1911, were presented in tabular form. The lamp manufacturers have announced an entirely new selling plan, intended to meet the decree of the United States Circuit Court entered on Oct. 12, 1911. The member companies were urged to follow a broad and liberal policy in encouraging the adoption and use of the tungsten lamp. In conclusion, the committee stated that it can render still further service to the membership by extending its scope to embrace not only incandescent lamps but all other forms of illuminants as well.

Discussion.

In the author's absence the report was presented by Past-president W. W. Freeman, Brooklyn. An extended discussion was participated in by Messrs. J. W. Lieb, Jr., New York City, and J. W. Howell, Newark, N. J. It was brought out that the carbon-filament lamp has unquestionably reached the limit of its usefulness and is now on the decline. The graphitized-filament lamp is to some extent becoming a substitute for the carbon lamp and is now available in several satisfactory types. A number of the larger companies have already standardized this lamp for customers' renewals, and it is manifestly to the interest of the smaller companies to adopt the same practice. Undoubtedly the tungsten lamp, however, is the lamp of the future, and the recent improvements made in its manufacture have greatly increased its general usefulness.

The graphitized-filament lamp is practically limited to ratings not smaller than 30 watts and not larger than 100 to 150 watts. Outside of this range the tungsten lamp is much superior. The tungsten-filament lamp in the larger sizes is successfully replacing the older types of series arc lamp for street lighting. Very recent improvements in tungsten lamps have made it possible to manufacture the small sizes used for sign lighting with a uniform size of filament. This makes it feasible to employ small tungsten lamps in sign lighting, connected in series-multiple groups, without giving any attention to the choice of sizes, as has hitherto been necessary. The recent improvements in increasing the durability of tungsten filaments have been so successful that the lamp companies have decided to ship tungsten lamps in cotton packing. While the graphitized-filament lamp is now replacing the carbon-filament lamp for customers' renewals, it is probably true that the lamp will give way in a few years to the tungsten-filament lamp, which, with further improvements and reductions in price, is unquestionably destined to be the lamp of the future.

LAMP CHARACTERISTICS.

Messrs. Robert E. Campbell and M. D. Cooper presented an elaborate paper on the considerations involved in the choice of proper lamps for the use of central-station consumers. The most important function of the central station is to furnish its customers with satisfactory light, which implies proper intensity and quality, with minimum fluctuation and maximum economy. The line voltage is the principal key to the situation, and the importance of voltage regulation is difficult to overestimate. Out of eighty-two of the smaller central stations visited by the authors, only twenty-eight used any form of automatic regulator for controlling the generator voltage. Another subject investigated was the accuracy of station voltmeters, and it was found that there is room for much improvement in this direction.

The authors went on to discuss the subject of distribution systems in some detail, with special reference to regulation, and presented typical regulation curves for small lighting transformers. The relation of voltage to revenue was illustrated by tables and curves. Determination of the proper lamp voltages in any central-station system is a matter demanding the most careful investigation and consideration. Concrete examples showing the losses attendant upon operating lamps at improper voltages were presented. For example, assuming a central station operating its lamps at 3 per cent below the point of maximum economy, it was shown that by raising the voltage to its proper value the revenue would be increased 5 per cent and the customers would receive 12 per cent more light. Again, if the voltage were increased 6 per cent the revenue would be increased 10 per cent and the customers would receive 24 per cent more light at the same cost per unit. An appendix was presented with the paper giving tables and data for 25-watt, 40-watt and 60-watt tungsten-filament lamps and for 60-watt graphitized-carbon-filament lamps, also including tables summarizing the conditions found in the eighty-two central-station systems visited and inspected.

Owing to the lateness of the hour, Mr. Campbell abstracted the paper rather briefly and laid special emphasis on the fact that the paper presents conclusions of the utmost importance to the average small central station, which has hitherto been inclined to neglect the refinements in voltage regulation, although it can ill afford to overlook them. On account of the late hour there was unfortunately no discussion, although the subject matter of the paper seriously merited further comment.

STREET LIGHTING.

The street-lighting committee, Mr. J. W. Lieb, Jr., chairman, submitted a fifty-four-page report dealing with both the economic and technical phases of street illumination. After briefly reviewing the history of the development of street-lighting equipment, the committee pointed out the present tendency to displace alternating-current series inclosed-arc lamps with luminous or with flame-arc lamps, and also noted the great impetus given to street lighting by the improvements in tungsten-filament lamps. In the more modern arc lamps there is a constantly increasing tendency toward greater steadiness, increased diffusion and better distribution of light. More and more the basis of comparison between different types of modern lamps is becoming the mean spherical candle-power, since the individual differences among different types of lamps are being largely eliminated by improved globes and reflectors.

In view of the careful tests which have recently been made by a number of other bodies, the committee did not consider it wise to undertake any such work on its own account, but presented abstracts of the reports of these tests in the form of several appendices to the report. The reports abstracted include the Colorado Springs case, the Waupaca (Wis.) case, the White Water (Wis.) case, the Sheboygan (Wis.) case and the Plymouth (Mass.) case.

In a brief symposium on the investigation of street-lighting systems, the committee pointed out the following fundamental considerations: Character of street, pavement and

surroundings; spacing, location, height and accessories of lamps; intensity and distribution of illumination, steadiness, glare and color.

In conclusion the committee pointed out the lamentable vagueness which is often present in street-lighting contracts and emphasized the desirability of correcting this defect in new contracts. It was also pointed out that contracts ought to be so worded as not to prohibit the adoption of new illuminants as the art develops.

Discussion.

President Gilchrist in commenting on the report of the committee emphasized its importance to the industry and stated that it was perhaps the most useful document of a practical nature presented at the convention.

COMPETITIVE ILLUMINANTS.

The report of the committee on competitive illuminants, of which Mr. F. H. Golding is chairman, contained much valuable matter bearing upon the displacement of gas-lighting installations by electric service. Special emphasis was laid upon the point that in many cases electricity can show a lower cost than gas, when all charges are properly figured. The report began with numerous practical hints concerning the preparation of cost estimates by solicitors of central stations, emphasizing the importance of carefully ascertaining the wattage necessary to do the work, the willingness of many merchants of the progressive type to install new lighting fixtures on the ground of their novelty or improvement over former types, and the value of straight cost estimates comparing competing systems.

A considerable portion of the report analyzed the comparative depreciation of gas mantles and tungsten lamps and effectively disposed of the adverse claims of gas solicitors regarding the effect of voltage fluctuations upon the candle-power cost of electric service. In many cases in the past the gas consumption of pilot flames has been overlooked in figuring costs. Eight gas cluster lamps consume by test 100 cu. ft. of gas per hour for the mantles and 2.5 cu. ft. for the pilot flames. An output from 15 cp to 25 cp per cu. ft. per hour is claimed for some types of mantle lamps, but the consumption of gas in open flames which have an output of from 2 cp to 4 cp per cu. ft. per hour forms a large proportion of all gas used for illumination. Not one installation in ten has been designed to meet particular requirements, and in many cases the consumer is using many more cubic feet of gas per hour than would theoretically be required to illuminate his premises with the latest type of gas lamp. Great divergence exists among laboratory candle-power tests of the same type of gas unit. The report gave a number of these, showing the unreliability of gas illumination from the standpoint of certain stated light-distribution curves. In some cases in the past manufacturers of gas lamps have employed test mantles or flash mantles with their lamps in order to show a high efficiency on photometric examinations. It is possible to obtain as much as 50 per cent in excess of the regular performance by this method. The life of such mantles is usually only a few hours. In some cases 50 per cent depreciation must be used to cover mantle costs.

The gas salesman frequently claims that a 5 per cent voltage drop will reduce the candle-power of a tungsten lamp by 17 per cent, and that running it at 5 per cent over voltage will cut the life in two. The inference is that in either case the operating cost will greatly exceed that at normal voltage. Running a tungsten lamp at 5 per cent below voltage does decrease the candle-power as stated, but it decreases the wattage 7.8 per cent and practically doubles the life of the lamp. Five per cent over voltage increases the candle-power 19.7 per cent, increases the wattage 8.1 per cent and halves the life. A typical case was worked out by the committee which showed that in the case of lighting circuits having a voltage regulation not exceeding 5 per cent it is unnecessary to make any allowance either for voltage fluctuation or for any other than the rated life of lamps when computing the cost of light per candle-power-hour with tungsten filaments. The question of dust removal was also discussed. The loss due to dirt is comparatively small per week of neglect, but mounts up seriously with time. At Knoxville, Tenn., the annual cost of cleaning on a three-week interval is 30 cents per lamp. At Rochester, N. Y., where about 9000 units are under monthly maintenance by the central station, the cost is still lower. The company charges from 9 to 25 cents per lamp per year, according to size, the lamps under 250-watt rating being maintained at 9 cents. The report concluded with data from central stations which showed among other points that ninety-one installations of gas cluster lamps having a total of 1057 mantles were replaced by an average per mantle of 68 watts in tungsten lamps. In almost all cases the customer has both saved money and secured more light. In another case, where eight 60-watt lamps displaced eight inverted gas lamps, the total operating costs, including renewals, were $45.20 and $52.03 for 1000 hours' operation.

Discussion.

In discussing the report of the committee on competitive illuminants, which was read by Mr. Ward Harrison, Cleveland, Ohio, Mr. R. B. Mateer, Denver, Col., advised the education of gas customers to a higher scale of service and illumination. Customers, he said, can be taught to demand good service without regard to cost. The central station should also make sure that shades and globes are up to the standard. Mr. C. Rummel, Vancouver, B. C., mentioned a new electric ignition device which avoids the use of pilot flames with gas cluster lamps. Mr. Rummel also used the committee's figures to show that with such ignition a substantial saving might be afforded in favor of gas. Mr. T. K. Jackson, Mobile, Ala., discounted the importance of battery ignition schemes, citing the troubles to which all such systems have been subject in the past. He advised careful maintenance of customers' installations, including the cleaning of lamps, and said that the adoption of this policy for his own company had made substantial inroads on the local gas business.

Mr. Ludwig Kemper, Albert Lea, Minn., insisted that gas competition should not be belittled and also pointed out that the average charge for energy is from 10 cents to 12 cents per kw-hr., which is considerably higher than the 8-cent rate cited by the committee. Mr. G. S. Thompson, San Francisco, Cal., declared that 80-cent gas about equals electricity at from 3 cents to 4 cents per kw-hr. Mr. M. C. Osborn, Spokane, Wash., said that experience with gas campaigns in the Northwest has usually been that more gas clusters than gas are sold. Mr. J. G. Learned, Chicago, said that the average solicitor may be fully trusted to lay out small installations, and pointed to the advertising value of electricity in competition with gas.

Mr. Norman Macbeth, New York, pointed out that unless both the gas and the burner are especially adjusted for each other the best results cannot be obtained with the stock fixtures on the market, since there is no standard lamp, burner, mantle or quality of gas. Flash, or self-igniting, mantles are not dependable and have short lives. In replacing gas installations the matter of cost should be subjugated to that of service, the first thing to be determined being simply what cost the equivalent service can be furnished for.

Mr. A. C. MacMicken, Portland, Ore., said that gas at $1 competes with electricity at 4 cents per kw-hr. He also estimated that to replace a gas cluster lamp costing $1 per month to operate 400 watts in tungsten lamps would be required, consuming 30 kw-hr., which, at 8 cents, the cost cited in the report, would amount to $2.40 per month. Mr. E. L. Callahan, Chicago, advised salesmen to lose sight of the fact that gas is cheaper, although admitting it if necessary. Instead, he urged impressing the customer with

the dependable service and sanitary features of electricity. Mr. T. I. Jones, Brooklyn, N. Y., said that since the cost of maintaining electric arc lamps is from 0.6 cent to 0.8 cent per kw-hr., it will actually be cheaper for the company to replace arc lamps free of charge with tungsten lamps having lives of from 1000 to 1800 hours and costing under $3. In the minds of most customers, he added, the cost will usually be found a secondary consideration to the quality of service rendered. Mr. L. G. Gresham, Bluefields, W. Va., declared that the replacement of gas cluster lamps with tungsten lamps is simply a question of salesmanship. Mr. A. Larney, St. Paul, Minn., told of the private efforts of a couple of local men who are doing a profitable business in installing tungsten fixtures to replace gas cluster lamps. These men work independently of the electric company.

Mr. Harold Ahlmet, Chicago, said that it is quite possible to get data on both sides of the gas-electric controversy. There are, however, three points to be observed in securing competitive business—education, service and cost—the last of which should be entirely subjected to the former paramount questions. Where natural gas is introduced into a city the electric business sometimes suffers for eighteen months or so, but invariably at the end of a couple of years customers return and the electric business takes on an even greater activity than formerly. Mr. G. K. Stetson, New Bedford, Mass., pointed out the sanitary disadvantages of gas. In closing the discussion, Mr. Ward Harrison declared that, while the committee feels that emphasis should be laid on the service side of electric competition rather than on that of comparative cost, an effort was made in the report, nevertheless, to supply cost data which might be useful. Only a small number of self-igniting mantles are yet installed, he said, so that for the majority of installations the penalty of pilot-flame burners is still in force. The convenience of electric illumination and the possibility of adapting incandescent lamps to their surroundings must not be overlooked. In the case of one gas installation which he mentioned, it had actually cost more to redecorate each year than the entire cost of lighting the premises by electricity, so that even with free gas a saving would have been made by using tungsten lamps.

DECORATIVE ELECTRIC ADVERTISING.

Through its chairman, Mr. William H. Hodge, the committee on electric advertising and decorative street lighting presented a fifty-page report, the greater portion of which consisted of data upon ornamental street lighting compiled for fifty cities in the United States and Canada under the direction of Mr. C. W. Bender, giving details of installation, costs, rates and electrical features. An illustrated book on ornamental street lighting has been prepared and published by the committee for the benefit of the general public, the cost of its publication being met by manufacturers producing ornamental street-lighting supplies and material. The first edition consists of 10,000 copies.

It was pointed out that only 275 out of 1874 cities of 5000 or more population in America now have ornamental street-lighting systems. Many opportunities exist for this class of development, which the committee vigorously contends in no way interferes with the benefits of other forms of electric sign, window and display lighting, when carried out in an intelligent way. Special opportunities exist in the proper illumination of public buildings, squares, etc. In the few cases where dissatisfaction has arisen with the ornamental illumination the trouble has been due, first, to a division of responsibility for payment for operation and maintenance; second, to lack of engineering skill and commercial foresight in designing installations, and, third, to burdensome expense in proportion to the size of the community's wealth and taxation.

The committee recommended that wherever possible the central-station company install and retain ownership of the ornamental system, contracting with the municipal authorities for an extended period on definite terms. Systems of ornamental lighting are potent factors in causing better pavement and many other improvements. They greatly increase the use of the streets after nightfall and contribute materially to the reduction of crime. An extended description was given of the pioneer installation of luminous flame-arc lamps at New Haven, Conn., and the appendix contains full engineering and commercial data from fifty municipalities in which noteworthy installations of ornamental electric lighting have been made. In general, most of this service stops at midnight or is continued all night on a partial basis by the use of divided circuits at each post. Usually the distance between posts varies between 50 ft. and 100 ft. All parts of the country are included in the data given. The revenue varies considerably, but the business is of the long-hour character and appears highly desirable. Both series and multiple circuits are operated, and charging is handled on the front foot and the lamp basis. Numerous valuable testimonials from business associations relative to the increase of street traffic and expansion of business due to ornamental lighting were included in the report.

The committee stated that there are now about 80,000 electric signs in service in the United States and Canada, containing about 8,000,000 clamps. Careful selection, designing and due regard to esthetic considerations are vitally important. The value of motion signs was emphasized. The electric sign is the one advertising medium which at the same time serves a distinct commercial use and renders a distinct public service in lighting the thoroughfare. No other form of outdoor advertising is so free from criticism. So far as possible all electric signs should be beautiful day and night. The average use of a display is eighteen hours a day. Central stations should be pioneers in the use of electric signs on their own account. The indications are that tungsten lamps are thoroughly satisfactory for sign service. The question of manufacturing interchangeable electrical displays is receiving much attention, the idea being to ship them from city to city in knock-down form. The possibilities in this direction are unknown as yet.

Discussion.

Mr. S. J. Rhodes, New York, complimented the committee on the value of its report, but criticised the limitation of data practically to incandescent-lamp installations with little mention of ornamental lighting by arc units. Mr. J. G. Learned, Chicago, Ill., recommended getting merchants or municipalities to pay all or part of the initial cost of installing post-lighting systems. It is often found desirable, he added, to make a special low, flat-rate, long-term contract, including upkeep and maintenance, thus making the business easier to renew upon expiration. Mr. R. B. Mateer, Denver, suggested that decorative brackets might well have been included in the committee's reports. Five-hundred-watt and 250-watt tungsten units are used with effect in some cities.

Mr. F. S. Baker, Butte, Mont., described the new Montana legislative enactment creating lighting districts, which taxes street railways one-sixth of the cost of installing and operating such ornamental systems. Mr. E. L. Callahan, Chicago, pointed out the objections to selling street posts to individual merchants or municipalities. In the first case installations may lack uniformity and in the second the danger of municipal ownership is enhanced. Mr. L. H. Newbert, San Francisco, Cal., described recent California legislation which permits the majority of the property owners in a thickly settled but unincorporated rural district to contract for lighting installations.

Mr. A. C. McMicken, Portland, Ore., described the system of 900 boulevard posts in the business district of Portland. The system there was inaugurated by interesting the more intelligent and progressive property owners, in this way securing probably better results than through profes-

sional salesmen. The installation of the street lamps, he testified, has produced no visible injury to the window-lighting standard. Mr. Norman Macbeth mentioned the primer on illumination, entitled "Light, Its Use and Abuse," recently prepared for the Illuminating Engineering Society by a committee composed of Messrs. L. B. Marks, New York; Louis Bell, Boston, Mass., and J. R. Cravath, Chicago, Ill. This pamphlet contains eighteen pages, with 3500 words of text and twenty illustrations, and will be sold at cost. The first copies will be ready Aug. 1.

Meters and Measurements.

REPORT ON METERS.

Mr. O. J. Bushnell, chairman of the committee on meters, presented a brief report covering the work of the committee during the year. The committee pointed out that one of the greatest existing difficulties lies in securing properly trained metermen. Accordingly, it was considered important to compile a handbook which would deal with meter matters in a simple practical way, appealing to the class of men obtainable for handling the installation, maintenance and testing of meters. The committee endeavored to include in the handbook all valuable information contained in the recent published reports of the meter committee, and also such parts of the meter code as have a bearing on the practical operation of the meter department. The committee has given attention during the year to the standardization of meter design and has secured the consent of several manufacturers to the adoption of a simple standard form of meter dial plates. The need of a much cheaper meter for very small consumers was pointed out. A number of additions to the Meter Code presented at the last Edison convention were submitted with this report as an appendix.

Discussion.

The discussion was participated in by Messrs. S. G. Rhodes, New York City; J. W. Cowles, Boston, Mass.; E. R. Northmore, Los Angeles, Cal.; J. Jenkinson, Vancouver, B. C.; Farley Osgood, Newark, N. J.; J. B. Seaman, Philadelphia; F. G. Vaughen, Schenectady, N. Y., and W. C. L. Eglin, Philadelphia. All who spoke expressed the greatest appreciation of the most important work performed by this committee during the year just closed. The "Electrical Meterman's Handbook" received the highest praise. Several speakers pointed out that this book should be placed in the hands of every meterman in the employ of member companies. One of those who discussed the subject suggested that if the metermen were required to pay for their copies they would probably treasure them more highly. It was the original desire of the committee to distribute one copy of the book free to each member company, but the executive committee found that the expense of doing this would be too great; however, the nominal charge of $2 per copy is less than cost for the first edition of 2500 copies. Several speakers emphasized the need for a cheaper form of meter for small installations. The use of ampere-hour meters was taken up at some length and it was stated that meters of this type are used to a considerable extent in Europe, where they are no longer regarded as an experiment. The hesitation to use them in this country appears to be due to lack of experience, and perhaps in some cases to a fear that the public service commissions will not approve them.

In discussing the methods of meter testing it was brought out that the three-point method costs practically no more than the two-point method. The proposal for standard meter dials received approval. It was also pointed out that it is preferable to standardize bottom terminals instead of top terminals. Another speaker referred to the burdensome restrictions imposed upon meter installations by the Canadian government, which requires that the seals be left unbroken for a period of five years. Mr. Eglin laid special emphasis on the value of the meterman's handbook to the smaller member companies.

METER SETTING.

An illustrated paper on meter installations, prepared by Mr. Severn D. Sprong, took up the commercial aspects of the problem, with special reference to small customers. The author presented a table showing the distribution of 35,000 meters among installations of different sizes. Five-ampere meters made up 58.8 per cent of the whole; 10-amp meters amounted to 20.3 per cent, and meters with a rating ranging from 10 amp to 25 amp amounted to 14.3 per cent. Considering particularly the small meters, which compose about four-fifths of the total, the author stated that the average cost of the meter alone is $15 and the average cost of installation is $13, making the total investment $28. The corresponding annual charges are $3.40. One of the problems now demanding the most serious attention is the development of cheaper metering devices for these small consumers. Among the principal considerations are the prevention of tampering with the apparatus and the theft of energy. The author pointed out that with the advent of lamps of still higher efficiency it may become economical in the smallest installations to serve the customer on a flat charge per lamp basis.

Discussion.

In the absence of the author the paper was read by Mr. D. Corbet, of Seattle. Messrs. S. G. Rhodes, New York City; H. L. Wallau, Cleveland, Ohio; O. J. Bushnell, Chicago; H. L. Gannett, Chicago; J. Jenkinson, Vancouver, B. C.; J. C. Henkle, Portland, Ore.; F. G. Vaughen, Schenectady, N. Y., and S. Hamilton, Portland, Ore., participated in the discussion.

It was brought out that the most satisfactory method of comparing meter costs is the kilowatt-hour basis. One of the speakers stated that several small companies had found that meter-testing devices resulted in an actual saving in maintenance costs. This view was not universally held, however, since another speaker stated that it seems paradoxical to increase the cost of small meter installations when the general consensus of opinion points to the great need of developing a much less expensive type of installation and also a cheaper meter. Meter protective devices, however, possess important advantages. One of the speakers referred to the unusual practice observed in Vancouver, B. C., of installing the meters over the front doors of residences. It was explained that the reason for doing this was the desire to read the meters as quickly as possible at any desired time. The effort to cheapen the meter installation sometimes requires the use of current-limiting devices, a practice which has not always been approved by public service commissions. An instance of the latter sort occurred in Ohio. It has been found, as might be expected, that the installation of meters outdoors greatly enhances the depreciation.

ELECTRICAL MEASUREMENTS.

The report of the committee on electrical measurements and values, of which committee Dr. A. E. Kennelly is chairman, reviewed the recent minor changes in the units of candle-power and voltage. On July 1, 1909, the Bureau of Standards, with the consent of the American Institute of Electrical Engineers, the National Electric Light Association, the Illuminating Engineering Society and the American Gas Institute, lowered the value of the unit of candle-power by 1.6 per cent, at the same time establishing uniformity with the standard adopted by Great Britain and France. This lowering of the unit resulted in a general increase in candle-power ratings, or if the candle-power

ratings remained the same it required a slight reduction in voltages. A 10-cp lamp under the old basis thus became a 10.16-cp lamp under the new basis. Again, a carbon-filament lamp having a specific consumption of 3.1 watts per mean hemispherical candle-power and giving an illumination of 16 candles at 110 volts, under the old basis, would need a reduction of emf to 109.7 volts in order to give 16 candles on the new basis. This corresponds to a reduction of 0.5 per cent in the power consumption. The general effect of this change has been to diminish by 1.6 per cent the amount of light furnished by lamps manufactured since the new standard became effective. At the same time the serviceable life, which expires when the candle-power falls to 80 per cent of its initial value, was increased to 7 per cent.

On Jan. 1, 1911, the Bureau of Standards, under international agreement, introduced a slight change in the value of the standard volt. The rated emf of the standard Weston cell was changed from 1.01913 volts at 20 deg. C. to 1.01830 volts at 20 deg. C., which amounted to 0.08 per cent. Automatically the standard ampere became larger at the same time by the same extent of 0.08 per cent, and the watt became larger by 0.16 per cent. Thus the magnitude of 110 new units was the equivalent of 110.09 old units, and in the case of 16-cp carbon lamps, of the type previously mentioned, the effect was to increase the candle-power and light by about 0.5 per cent.

While these two changes tended to offset each other, the effect of the change in the candle-power unit was the greater of the two. In conclusion the report states that the change both in candle-power and voltage went regularly into effect at the Electrical Testing Laboratories in New York without any difficulty or serious inconvenience.

Discussion.

Owing to the absence of Dr. Kennelly, the report of this committee was read by Mr. J. W. Howell, of Newark, N. J. It was discussed briefly by Mr. J. W. Lieb, Jr., of New York City, who expressed the hope that a future international congress will ratify changes in the candle-power and voltage units which have been adopted by the National Bureau of Standards and ratified by the United States and several foreign countries. While the changes in the values of the units are small and ordinarily regarded as negligible in a commercial sense, this is not invariably true. The speaker presented a table showing various examples of the final effect resulting from both changes in units. For example, a 16-cp carbon-filament lamp which had a specific consumption of 3.1 watts per mean horizontal cp before either change became effective would now give 16.83 mean horizontal cp when operated at 50 watts and would also have a specific consumption of 2.97 watts per cp; at the same time the economical life would be diminished by 14 per cent.

A written discussion was contributed by Dr. C. H. Sharp, of New York City, presenting elaborate comparative tables showing the effect of the changes in units. This was not read, but will be published in the proceedings.

Accounting.

UNIFORM ACCOUNTING.

The committee on uniform accounting, through its chairman, Mr. E. J. Bowers, reviewed the entire work of the committee in the past, made recommendations for the future, and desired particularly to urge the adoption of the association system of accounts by all member companies. Up to the time that the accounting committee began the work of establishing a uniform system of accounts for electric utility companies, the development of the electric lighting industry had progressed so rapidly, without consideration of the matter of accounting, that many companies found their records in a hopeless tangle. Except in a few of the larger and older companies, no accountants were employed by the electric-light companies in the supervision of their books. To-day the accounting division of electric corporations is a very important branch of the business. The labors of the committee in the compilation of the standard classification of accounts, and the constant efforts made from the inception of the task to induce member companies to adopt the classification, have laid the foundation for the higher and better accounting of the industry.

At a meeting of the accounting committee which was called on May 4, 1912, it was proposed to recommend to the executive committee an increase in the membership of the accounting committee from eleven to fifteen. It is also deemed advisable that sub-committees be appointed on the following subjects: public service commission relations; standard classification of accounts; statistics and costs; forms.

The most important problem to-day is the relation of public service utilities to public service commissions and the public. It is obligatory upon all companies under the jurisdiction of commissions to keep their accounts in a uniform manner. The probabilities are that every legislative body in the United States will establish commissions to control public utilities. It is necessary for every member company in the association to keep its accounts according to the standard classification. This will have a decided tendency to induce new commissions to accept the accounts. The committee recommended that a sub-committee to make certain revisions in the standard classification be appointed, and that this work be taken up immediately. The committee has compiled for comparative purposes, and presents with its report, the titles of the fixed capital, construction and equipment accounts prescribed by the National Electric Light Association, the Public Service Commission of Maryland, the New York Public Service Commission, Second District, the Interstate Commerce Commission, and the Railroad Commission of Wisconsin.

The committee stated that it is desirable to determine the advisability of the maintenance of a statistical bureau of the association, for the purpose of the compilation of statistics from the various member companies. The association is besieged with requests from various concerns for information concerning the operations of central stations. It has been found that the association is asked repeatedly for standard forms of the various records, books, etc., needed and used by the member companies.

Discussion.

The report was discussed by Messrs. R. H. Ballard, Los Angeles; H. E. Addenbrooke, Chicago; W. F. Gardner, New York; L. P. Faulkner, Olympia, Wash.; J. D. Butler, San Francisco; H. Spoehrer, St. Louis, and M. Hallgren, Seattle.

Mr. Ballard pointed out that the California Public Service Commission will probably adopt the association's classification of accounts in the main. The capitalizing of franchises, royalties and licenses as provided for in capital account No. 2 will have to be avoided, as the commission does not favor the capitalization of franchises.

Mr. Addenbrooke urged the committee on accounts to get in touch with the smaller companies, pointing out the benefits of a uniform system for purposes of comparison. Mr. Faulkner agreed with this point of view and showed how the adoption of an account classification on a small group basis would facilitate the work of the smaller companies and enable the larger companies to make important comparisons with the former, even though these might not go into great detail. Mr. Butler said that in San Francisco a franchise has no capital value whatever, and Mr. Spoehrer stated that in St. Louis franchises are taxed by the municipality, although the rate commission prohibits the

valuation of franchises. The company capitalizes its going value and certain licenses. In closing, Mr. Spoehrer pointed out the desirability of all companies adopting the association's classification so far as possible. He stated that the Wisconsin commission at first recommended the separate transmission and distribution of the investment in connection with underground systems. This has been found impracticable, and in the next classification issued by the commission it will be rectified.

INCANDESCENT LAMP ACCOUNTING.

Mr. W. H. Bogart, New York, in his paper on "Incandescent Lamp Accounting of the New York Edison Company," described the system by which that company keeps track of its large stock of lamps. All new incandescent lamps are received at one storeroom, and from that point are delivered by electric vehicles directly to customers, or are transferred to district storerooms to await the call of customers. In the main storeroom a dry loft is kept for the economical handling and storage of standard packages or "wholesale" stock. Part of the loft is partitioned off into a room with easily accessible bins and drawers, in which broken packages comprising the retail stock are kept. The storerooms are arranged in this manner in order to prevent collusion between employees and to segregate the storeroom and delivery features. A district storeroom is located in each of the four districts into which the company's stock is divided, and card indexes of customers are maintained, in order that the right of the customer to free renewals may be determined. The information on the card indexes is posted from the connect and disconnect notices from the contract department. Incandescent lamps are delivered to customers by thirty delivery wagons. The orders of customers for incandescent lamps are sent to the district storerooms, which verify the name and address and enter the order on a daily request sheet. A lamp receipt is made out and at 5 p. m. the request sheets and receipts are sent to the main storeroom, where a night force makes up, routes and loads delivery wagons so that the men are able to start promptly at 8 a. m. on a definite route. The lamps are checked out by an inspector as they are loaded on the wagons. On returning from their trips the delivery men fill in on their check sheets the number of lamps delivered, and this amount is deducted from the quantity received, so that the balance on hand must check with the balance shown on their check sheets. The number of old lamps returned must also check with the number of new lamps delivered. After each wagon is checked the broken packages are repacked by a night force into such standard packages as are used on the delivery wagons and returned to the retail stock.

A system by which the stock of lamps is checked and cared for, as a means of perpetual inventory, in order to detect error and prevent fraud, is carried on constantly. At the end of each month the storeroom stock cards are checked against the general lamp ledger, so as to reveal any errors in the posting. An assistant storekeeper counts each day every package of the wholesale stock, which must check with the stock of the previous day plus or minus the receipts and deliveries. A daily check is made by the retail and district storerooms of the lamps in stock and on wagons, which must check in the same manner. In addition, a lamp checker and two assistants give their entire time to the checking of lamps. The prevention of traffic in lamps is accomplished by a card record, which shows the customer's name, address, business, date of connection, installation and number of lamps allowed, the number, kind and size of lamps delivered and returned, the date of change and the number of lamps the customer has on hand. The customer is considered to be conducting a traffic in lamps when he returns lamps which his last balance shows he did not have to return, or when his purchases are very frequent and his returns correct, but the average life of the average lamp during a certain period is unreasonably low.

The number of incandescent lamp customers of the company on March 1, 1912, was 97,000; during the year 514,941 visits were made, and customers were served 321,777 times. Following are details regarding the lamps returned from circuits during 1911: Dim, 796,018, or 26 per cent; exhausted, 1,819,316, or 6 per cent; stubs, 435,930, or 14 per cent. Lamps were delivered as follows: Periodic delivery, 894,802; request delivery, 2,687,034; counters at storerooms, 521,572; total, 4,103,408. About 61 per cent of the dim lamps are found to be good enough to re-issue to customers.

Discussion.

The paper was exhaustively discussed. President Gilchrist emphasized the great opportunity existing for saving money in the handling of lamps. Mr. J. W. Lieb, Jr., New York, called attention to the great importance of the lamp item and touched upon the benefits of checking lamp life by a kilowatt-hour comparison. The prevention of traffic in incandescent lamps is very important. Very close checking is necessary where an allowance is made on tungsten lamps and carbon lamps which have been used. Graphitized-filament lamps are now standardized in New York for free removal, most carbon lamps being given out to customers. The improvement of tungsten lamps is gradually driving out the practice of installing them in consumers' sockets under the direction of the company.

Mr. Douglas Burnett, Baltimore, described a ticket and tabulating machine system used in connection with the handling of lamps in his city. One set of stock records suffices instead of the five required according to the paper. Mr. Burnett said that a wagon stock is carried in Baltimore, and this does not inconvenience customers.

Mr. H. Spoehrer, St. Louis, favored having the driver install new lamps and remove old ones. It was generally agreed in the discussion that it is inadvisable to include auxiliary charges on bills for electric energy. The cost of delivery per lamp varies from 3.5 cents to 8 cents, which is too large a percentage of the first cost of the lighting unit. Mr. Lieb mentioned the fact that a liberal policy in regard to the removal of lamps tends toward large returns from the sale of energy as well as maintaining a higher candle-power standard.

Mr. H. B. Gear, Chicago, pointed out that on the Commonwealth Edison system the delivery of lamps is handled by the operating department. Separate stock accounts and separate store accounts are kept under the supervision of a general storekeeper. The cost of delivery per lamp is 3.5 cents, including delivery wagons, office expenses and supervision. The storage charge is taken care of by a general charge. Over 800 telephone calls per day are received in the winter months from customers desiring new lamps. The lamp wagons carry trays holding fifty lamps each, and as they are taken into the consumer's premises by the drivers and also used in the carriage of returned lamps, the ill effects of rough handling are obviated. The use of these trays saves more than enough lamps to pay the cost of equipping the wagons with trays and carrying cases. Mr. Gear advocated placing checks against temptations to the misuse of lamps by employees. Mr. R. S. Hale, Boston, said that the cost of delivery is less than 3 cents per lamp on his system. The first installations are handled by meter wagons and old lamps are removed by other vehicles.

Mr. Will Brown, Salt Lake City, said that the free-renewal plan is not in use in his city. The customer brings the old lamps to the office and receives the new ones at a nominal price. Mr. Gear cited the effective use of lock sockets in tungsten clusters as a preventive of lamp transfers in installations supplied on the double plan of free and charged renewals. Mr. Lieb said in closing that the Public Service Commission of the First District, New York, is opposed to discontinuance of service on the ground that the customer fails to pay for other than energy consumed. Messrs. F. M. White, Spokane; C. Rummel, Vancouver;

V. G. Shinkle, Spokane, and F. M. Willoughby, Denver, spoke briefly.

ACCOUNTING FOR SCRAP MATERIAL.

In a paper by Mr. Charles E. Bowden it was stated that the central-station business produces a large amount of valuable scrap material. Very few companies have enough scrap to make it economical to establish a special department to handle it, and for this reason it is advisable that this work should be done by the purchasing and stores bureau.

On analysis, the company with which the author is connected found its sales of scrap to consist principally of insulated copper wire, ends of lead cable, cast and wrought iron, incandescent-lamp stubs and burned-out lamps. Such poor prices had been received from these sales that it seemed scarcely worth while to continue them. It was found on investigation that the principal reason for the low prices that had been received was that all kinds of scrap had been thrown together in a portion of the yard and the various kinds mixed so hopelessly that when bids were desired the material had to be sold for whatever was offered, since the cost of proper assortment to the bidder would be more than he could secure. This condition was corrected by the use of a small outbuilding, which was fitted with a number of large bins in which various classes of scrap were segregated.

The economical disposition of insulated copper and lead cable is the most important problem in connection with the different materials handled. The insulation is burned off and with ordinarily careful handling good copper remains. The lead cable is melted on a steel plate and runs by gravity down a groove into a pot, where the dirt is skimmed off and the lead is taken up in ladles and cast into pigs. Burned-out incandescent lamps are divided into two classes. The lamps which are burned black are broken up and the stubs saved for the platinum, the rest being thrown into a bin to accumulate. Clear lamps are packed into barrels and shipped to the factory, where new filaments are placed in them. All sales of scrap metal are made by the purchasing agent, and by studying to take advantage of the market he can often save more than his salary for the company during the course of a year. Scrap copper is used by smelters to a great extent in producing casting copper, and a number of the larger companies sell their scrap to smelters at a price based on the New York price of cast copper. Pig lead is used mostly in the plant of the company for making solder. Iron is allowed to accumulate until the bins are full, when bids are received. Lamp stubs are sold in 1000-lb. lots at 10 cents per lb., and clear burned-out lamps are sold in barrels of 500 at $5 per barrel, the prices in all cases being f.o.b. at the warehouse of the company. In the last three months over $50,000 worth of scrap material, mostly copper, has been sold, and efficient handling has resulted in a saving of over $10,000 for the company on these transactions.

Discussion.

The paper was briefly discussed by Messrs. H. T. Hughes, Denver; E. C. Scobell, Rochester, N. Y.; S. H. Wallace, St. Louis; C. B. Smith, Portland and Ernest Rogers, Vancouver. The discussion dealt mainly with the importance of disposing of scrap and crediting repair jobs with the salvage value of material taken out and the charging of depreciation on stock held in storage for long periods.

GENERAL FILING SYSTEMS.

Mr. R. H. Williams presented a paper in which it was stated that experience had shown that some one person should be appointed and held responsible for the filing and safe-keeping of the records of a company, with the idea of passing them on to his successor, thus completely filling up all gaps and preventing the destruction of records through lack of knowledge of their importance and of the previous history of the company. In most companies the secretary is the one appointed by the by-laws to do this, but in cases where that official has several other departments he cannot do more than supervise the work.

Practical utility and economy are the two essentials in the organization and management of a central filing department in which the records, papers, books, etc., of a well-regulated business house or corporation are kept. Theoretical refinement which would tend to limit the utility and increase the expenses of the system of filing should be avoided. The general mistake of failure to realize the importance of a provision for filing records early in the history of the company has been the cause of much annoyance and expense.

When indexes are made the important factors are accuracy, simplicity and quickness of reference. The fundamental idea in correspondence filing is to bring together in one folder all letters to and from each correspondent or referring to any given subject. Another important duty of the file clerk is the disposition of books of accounts, vouchers and records from the auditing department. The filing of work orders and job order tickets for wiring and other jobs should be numerical. The contract for the job, however, should be filed separately. It will be found advisable to file alphabetically all applications and classes of contracts for electric lighting and motor service.

The relative merits of central filing and departmental filing systems are difficult to determine and necessarily depend upon how long it is necessary to hold open for immediate use the files of each department. No record should be taken from the file room until a receipt is given. Some reference card or record should be kept of outstanding papers, and inquiries should be made periodically for any papers that have not been returned.

Discussion.

Mr. E. M. Podeyn, of Brooklyn, exhibited a chart system for the filing of correspondence without the use of the card index, which has reduced the cost of handling such matter by about 33 per cent. The Boston Edison Company is using the same system. Mr. H. E. Addenbrooke, Chicago, stated that a single file clerk and two boys take care of the entire correspondence, meter records, etc., of the Commonwealth Edison Company. Mr. A. D. Spencer, Detroit, emphasized the need of properly identifying records before putting them permanently away, and Mr. J. H. Donlan, Brooklyn, pointed out the benefits of stamping all matter intended for the general file with the date and name of the person sending it in. Others who spoke briefly were Messrs. L. A. McArthur, Portland; H. Spoehrer, St. Louis; E. J. Bowers, Kansas City; E. C. Scobell, Rochester; C. G. M. Thomas, New York, and H. S. Knowlton, Boston.

THE SALE OF ELECTRIC DEVICES.

Mr. L. M. Wallace, in his paper on accounting for the sale of electric devices, stated that the proper method of accounting to be adopted depends somewhat upon the policy followed in the operation of the electric appliance exchange. If this department is considered as a part of the sales department, the costs of operation would be placed naturally in the classification of commercial expenses and could, if desired, include such of the general expenses as might be apportioned directly thereto, while the profit from the sale of electric devices would be accounted for in the miscellaneous income of the company. If, however, the electric appliance exchange is operated in a measure independently of the sales department, although nominally under the jurisdiction of the superintendent of sales, the method of accounting would be in accord with such a condition.

The electric appliance exchange of the Edison Electric Illuminating Company of Boston is operated practically on a self-supporting basis. This exchange, however, is not charged with any portion of the general expenses, such as rent of main showroom, cost of care and handling of supplies in the general storehouse and the cost of accounting in the accounting department. The proper proportion of the

general expenses could be charged if it should be considered desirable to do this. The exchange expenses include all salaries and miscellaneous expenses of the superintendent directly in control and of such salesmen, demonstrators and clerks as are employed in and about the showroom. These expenses appear on the debit side, while the profits from sales show on the credit side of the "miscellaneous electric devices, losses and gains" account.

The cash price at which electric devices are sold depends somewhat upon conditions existing at the time. The purpose of the exchange in selling electric devices is to introduce and increase the use of electricity by the customers of the company; hence the matter of profit on any particular kind of device is a secondary consideration. To the cost price of all electric devices leased on the sales basis a profit of 12 per cent per year is added for the time allowed for the lessee to pay for the device, and the monthly rental charged is based on the net cost of the device plus 1 per cent per month for the whole lease period.

The system of accounting has been planned to meet the operating conditions of the exchange, and the controlling or general ledger accounts, with the subdivision accounts, are as follows:

Controlling or General Ledger Accounts.	Subdivision Accounts.
Stock on hand.....	Miscellaneous electric devices, subdivided according to location.
Sundry open accounts..	Miscellaneous electric devices on consignment.
	Miscellaneous electric devices, accounts payable.
	Miscellaneous electric devices leased.
	Miscellaneous electric devices rentals.
Miscellaneous profits...	Miscellaneous electric devices, losses and gains, subdivided according to information desired.
Accounts receivable....	Customers' accounts.
Accounts payable.....	Venders' accounts.

Discussion.

The paper was discussed by Mr. Ernest Rogers, Vancouver, B. C., who said that in his city a self-contained department for the sale of devices is in service. Some of the minor expenses of administration are not charged to the department but are included in the general expenses of the company. All appliances are requisitioned through the purchasing agent and charged to the general stock account. The company carries about $10,000 worth of appliances. A monthly statement of appliances is made up showing the number on hand, costs and sales. The appliances are recorded in a loose-leaf ledger, with the exception of washing machines, which are sold on the instalment basis and separately accounted for.

SCIENTIFIC MANAGEMENT.

Mr. Franklyn Heydecke, Newark, N. J., said that the first essential in the scientific management of an accounting department is to have a strong organization. The head of the department should be thoroughly familiar with all accounting subjects and should know each employee's work and how it is done. Each man should be so placed that his best efforts will be put forward. The employees should be required to know the relation of their work to that of the other men. An occasional examination could be made with good results. When a man is promoted he should be encouraged with an increase in salary. When a man reaches his highest point tell him so. Let him know that he is getting as much salary as he will ever receive in the office or that he has reached the highest position obtainable. All general announcements should be posted on a bulletin board and general directions should be acknowledged by the signature of various employees. So far as possible, all work should be outlined for the men. The highest state of efficiency is realized by the scientific direction of the work to be done by the individual rather than by labor-saving devices.

Discussion.

The paper was discussed by Messrs. J. D. Butler, San Francisco; John Priestman, Vancouver, B. C.; H. Spoehrer, St. Louis; Ernest Rogers, Vancouver; H. T. Hughes, Denver; E. C. Scobell, Rochester; E. T. Bowers, Kansas City, and P. S. Young, Newark,

Mr. Butler emphasized the need of reliability, endurance and activity in individual members of the accounting force. The physical condition of the employee is a prime factor in the economy of departmental administration. Clerks should be taught to pay strict attention to business and to avoid falling into the practice of "clock watching." Overtime should be cut out as much as possible by carefully planned team play.

Mr. Priestman said that accountants should learn to overcome obstacles in the spirit of engineers. Personality is a great factor in individual advancement. He also contended that the use of standard forms and systems is a matter of much importance and favored the examination of employees upon the knowledge of their work at regular intervals. Records should be routed through the department in a logical fashion. Mr. H. Spoehrer, St. Louis, employs engineering graduates as accounting associates. Their training in the solution of difficult problems makes them logical and efficient workers when properly educated in the needs of the department. He favored the establishment of a fixed salary for each position, with a bonus at Christmas time for exceptional work. Systematic work is absolutely necessary, and too many detailed considerations are undesirable. The consensus of opinion was that a college training is a desirable feature of the accountant's preparation for life, although Mr. Rogers favored employment of high-school graduates. He felt that the employee should acquire a better fund of information regarding the general trend of company business and equipment.

Mr. Hughes briefly described the Doherty training system for cadet engineers. Mr. Scobell described the accounting organization of his company, and pointed out the advantages of qualifying understudies in the administration of departments.

MOTOR VEHICLE COSTS.

Mr. E. C. Scobell, Rochester Railway & Light Company, outlined plans which appeared to him to be the best to follow in the treatment of motor-vehicle costs. They are the result of the combined experiences of several leading central-station companies in the East. He suggested two classifications for large and small companies as follows:

For large companies: (1) Battery operation; (2) battery renewals; (3) mechanical parts; (4) chassis; (5) repairs and painting of body; (6) tire expenses; (7) cleaning, care, etc.; (8) electricity; (9) sundries; (10) office salaries; (11) office expenses; (12) garage wages; (13) garage expenses; (14) rents, insurance, etc.; (15) garage maintenance; (16) depreciation; (17) vehicles hired; (18) chauffeur wages.

For small companies: (1) Batteries; (2) vehicle repairs; (3) tire expenses; (4) miscellaneous; (5) office expenses; (6) sundry garage expenses; (7) depreciation; (8) vehicles hired; (9) chauffeur wages.

Each vehicle should be given a serial number when it is purchased, and it should be known and designated thereafter by that number. An account should be opened for each subdivision of the foregoing classification preceding "cleaning, care, etc.," for each vehicle, and a general account be opened for the charges whose nature prevents classification directly to any particular machine and which must therefore be prorated. The cost of pneumatic tires and repairs thereto should be charged to a general account and prorated on the basis of miles traveled to the vehicles using such tires. The accounts for "cleaning, care, etc.," to "depreciation" should be prorated monthly to each vehicle in the proportion that its load rating bears to the rating of all. Another basis of distribution, an admirable one, is the percentage occupied by each vehicle of total square feet of garage area. Either basis is preferable to a mileage basis for these accounts. The amount and the method of arriving at the amount to be charged for depreciation is

debatable. A simple and effective method is to charge 20 per cent of the purchase price the first year, 15 per cent of the balance the second, and 10 per cent of the balance at the close of each year for the succeeding years. Under this plan the charges for the first two years will be heavy and the repairs small. In later years, when repairs are heavier, depreciation charges decrease.

In addition to cost keeping, provision must be made for statistical and efficiency data. A record should be kept of the energy used in charging batteries, the reading of the ampere-hour meter and the odometer. This record may be kept in the garage and submitted monthly, or it may be made up from reports rendered to the cost-keeping department each day.

The tire record will prove more troublesome than any other record in connection with vehicle operation. Each tire should receive a serial number when it is purchased. After experiment the plan has been adopted of numbering the wheels on all vehicles and keeping a record of the tire through the wheel on which it was used. This necessitated a card record for each wheel, in addition to a card record for each tire. The total mileage was computed and compared with the guarantee, and when the record was not equal to the guarantee a claim was made on the dealer or manufacturer from whom the tire was purchased. The card record for a battery is of the same size as the card used for the records of tires and wheels. A card is made for each battery as cars are purchased, or for new batteries as they are required to replace old batteries. One form is used for a summary of all costs and other data. Information in regard to miles run, kilowatt-hour input and number of charges is obtained from the charging report. With this information the kilowatt-hours per mile, the miles per charge, the unit cost per mile traveled and per hours used are computed and entered on this form. The operating cost and the fixed cost are transferred from detail expense sheets and totaled. The credit column shows the charge made for the use of the vehicle and may be more or less than the cost of operation for any particular month. The hours in service figures are obtained from a daily report turned in by each driver.

The actual monthly cost of maintenance and operation of a car varies. It would be an unfair distribution if the accounts or jobs effected in any one month were charged with extraordinary repairs to the vehicle during that month. It is desirable that the charge made for the use of a car be as near the average cost as possible, and it may be based on the average monthly cost or the average cost per hour of service. Only through experience is it possible to arrive at what the average cost should be. The charge, however, should be sufficient to accumulate a credit for the extraordinary repairs that will be necessary.

Discussion.

The paper was discussed by Messrs. H. T. Hughes, Denver; A. H. Manwaring, Philadelphia; George R. Stetson, New Bedford, Mass.; E. J. Bowers, Kansas City; H. Spoehrer, St. Louis; Douglass Burnett, Baltimore; H. B. Lohmeyer, Baltimore, and S. B. Howard, Detroit. Mr. Hughes complimented the author upon the completeness of the paper and stated that the Denver company is just beginning to make analyses of its transportation costs.

Mr. Manwaring described the system of keeping track of tire and battery costs used in Philadelphia. These are figured on an arbitrary mileage basis, determined by a study of individual costs. When a new vehicle is purchased the department credits the property account with the price of the tires and battery and charges this into the stock account. A rate per mile per tire and per battery is made up, and the vehicle expense account receives a daily charge upon this basis, the total being a function of the number of miles of service. Tire tags are successfully used. The company has a separate transportation department. When a vehicle is used on a construction job its service is charged to the work like that of any other material. Garage charges are determined according to the character of the vehicle.

To an expensive limousine car a higher charge is given than to a truck on account of the greater amount of attention required by the former. Mr. Scobell said that he prorates pneumatic tires over all vehicles on a mileage basis, solid tires being charged directly to the machine in question. Mr. Stetson touched upon the nominal cost of electrical energy for the operation of central-station motor vehicles and cited the great flexibility of such machines. In one case 3 tons of gas pipe were delivered at a distance of 1.25 miles in twelve minutes, a feat obviously out of the question with horse traction. The new Baltimore company has no gasoline cars in its service, believing that central stations should adhere strictly to the electric vehicle.

Mr. Bowers stated that at Kansas City the total cost of operation of electric vehicles averages 25 cents per car, the machines varying in size from 250 lb. to 3.5 tons. For light work the motor cycle at 3 cents per mile is the cheapest method of efficient transportation available. The Kansas City company prorates the garage charge according to the number of cars stored, as the garage is shared with the local electric railway.

Mr. Manwaring said that at Philadelphia the total cost, including all charges, is about 21 cents per car-mile for electric vehicles. He emphasized the importance of standardizing meter connections in making vehicle comparisons, urging that meters be connected between the rheostat and the battery.

Mr. Spoehrer mentioned the healthy growth of the vehicle business in St. Louis and pointed out that the company has now found it possible to give up maintaining a pleasure-vehicle garage in that city on account of the commercial interest displayed in such work. It still maintains a truck garage. The company's object is not primarily commercial, but to demonstrate locally the advantages of proper garage administration.

Mr. Lohmeyer described a system of charging accounts used in Baltimore on vehicle service. Material is prorated on all cars on the basis of their size, all items being estimated on the per mile and per hour basis. Data are compiled only when needed. He favored Mr. Scobell's plan of depreciation charging. The chauffeurs' wages are charged to the department using the car. About sixty vehicles are in service and the company endeavors to keep the maintenance expense low by handling cost keeping in the auditing department. Mr. Manwaring added that a single clerk keeps all of the records of the electric vehicles used for the Philadelphia company, most of the auditing being obtained from the operators of the machines. Mr. S. B. Howard, of the General Motors Company, of Detroit, offered to supply electric-vehicle service cost data to all delegates desiring to be placed upon the company's mailing list.

REGULATED ELECTRIC-LIGHT ACCOUNTING.

Mr. H. M. Edwards, of New York, described the workings of the accounting system prescribed by the New York Public Service Commission, First District. This system has now been in effect three years, and the commission has been asked in a petition signed by nearly all of the companies under its jurisdiction to make certain changes. An abstract of this petition in reference to these changes was published in the issue of the *Electrical World* for Dec. 9, 1911.

After describing certain rules included in the accounting order of the commission, Mr. Edwards stated that it requires not only a high order of accounting ability to follow the rules literally but also a general knowledge of the business. Many small companies throughout the State of New York are absolutely unable to fulfil the requirements, as they have not the original records necessary or the kind of talent in their accounting or managerial departments to

produce the results demanded. In the opinion of Mr. Edwards, the division of capital charges into original additions, betterments, renewals and replacements is an unnecessary refinement. Thus far he has been unable to perceive that results commensurate with the necessary amount of labor have been secured. Neither the system prescribed by the Railroad Commission of Wisconsin nor that of the Interstate Commerce Commission embodies these features of capital subdivision. The Public Service Commission of Maryland has followed the example of the New York commission, but not with the same degree of particularity.

Concerning rule No. 22, which relates to betterments involving the partial destruction of things bettered, Mr. Edwards says that too much estimating is required. The purpose of the accounts is to show the cost of things, not necessarily their value. It is a mistake to attempt to combine the accounting for capital expenditures with appraisals of property.

In his discussion on the subject of depreciation, Mr. Edwards said that when that matter was under consideration the representatives of the lighting companies urged that no rate of depreciation or method of determination of the amount be prescribed by the commission, but that the amount of the reserve should be left absolutely to the discretion of the companies. It was urged that depreciation is local in nature and extent, and that conditions vary in each company. The commission has recognized this fact generally in its rule, except that it has provided that the amount to be reserved shall be lessened by the amounts charged to the various repair accounts in electric operating expenses, and this seemingly minor requirement has been the occasion of a great deal of trouble. The directors of the New York Edison Company had decided some years before to charge to depreciation and credit to the corresponding reserve account a sum equal to 1 cent per kw-hr. sold, and this sum has proved to be ample for the purpose. As the rule did not conform to the technical requirement of the commission in regard to the amounts charged for repairs, the company was requested to amend the rule and add to the amount of reserve an additional amount which, when repairs should have been deducted, would leave the equivalent of 1 cent net per kw-hr. sold. The additional amount was determined by the repair records of the previous five years, but owing to unforeseen operating conditions in subsequent years, the repairs were not sufficient to absorb the extra amount reserved, and in its accounting the company continued to charge off 1 cent per kw-hr. sold, although the rule as filed with the commission would have called for 1.2 cent per kw-hr. Therefore, the company has not conformed technically to the requirements. The commission has not decided definitely whether the company should be required to set aside the additional 0.2 cent per kw-hr. The rule of the Wisconsin commission is simpler. In commending the system prescribed by the Wisconsin commission, Mr. Edwards said that this classification was evidently devised by practical men for the everyday use of an intensely practical industry.

Discussion.

The paper was discussed by Messrs. J. W. Lieb, Jr., New York; William Hagenah, Chicago, and C. N. Duffy, Milwaukee.

Mr. Lieb paid a high tribute to the Wisconsin commission's classification of accounts as a practical working schedule. He said that the use of the account known as "approved amortization of capital" required by the New York commission is objectionable, a preferable substitute being "renewal and contingency account." The commission required the New York Edison Company to apply its surplus to the account unless it follows the recommendation of the board with regard to the amortization of capital. The company has recently petitioned for the right to carry a reserve fund. The removal and contingency account is an expense and an item to be included in the price of service and not taken from the profits of the enterprise. Some companies hold that a contingency fund should be kept intact; others think it right to invest a fund in extensions and other improvements. The whole question of depreciation, contingency and renewal funds is now before the industry, and the present time is ripe for companies to begin to charge a contingency fund into their accounts. Mr. Lieb pointed out that the selection of a 1-cent (per kw-hr. sold) renewal and contingency charge by the New York Edison Company was based upon experience, and said that the Public Service Commission of New York has approved the general plan of making a unit charge of this kind.

Mr. Hagenah, who was formerly statistician of the Wisconsin Railroad Commission, said that he could see no objection to handling the contingency account on the basis described by Mr. Lieb. He further pointed out that the Wisconsin commission had made special efforts in placing its classification of accounts to steer away from actual management, believing that uniform classification, publicity and adequate reserve were the main objects. Companies must protect their property from the ravages of depreciation. The New York commission went much further into detail than did the Wisconsin board and almost encroached upon management. Many conferences of the public utility organizations were held by the Wisconsin board before its classification was adopted.

Mr. Duffy agreed that the work of the order system covering capital expenditures is unobjectionable. He said that the cost of labor should include only wages, salaries or fees paid to employees, and not personal expenses. The division of capital expenditure charges into original, additional, betterments, renewals and replacements is an unnecessary refinement. The capital account should show the cost of property regardless of value, and repairs should be taken care of under depreciation reserve. It is undesirable to charge all retired capital to surplus instead of to the credit of the depreciation reserve when there is a balance to the credit of the depreciation reserve. Mr. Duffy closed by paying a high tribute to the work of Mr. Hagenah for the Wisconsin board.

THE TABULATING MACHINE.

Mr. William Schmidt, Jr., of Baltimore, followed the paper on tabulating machines which he presented at the 1911 convention with an address at this convention in which he described the progress made during the last year and answered many questions that had been received as a result of the previous paper. To a company that is about to adopt the tabulating system Mr. Schmidt suggested that a man who has been employed by the company for some time be selected to take charge of the work. This man should visit a company which has the system in operation.

The tabulating system is based upon the use of cards known as tabulating cards. One of the first uses in which the system was applied by electrical companies was the tabulation of electric energy sales for statistical purposes. Mr. Schmidt recommended that girls rather than men be employed to perforate the cards as they are more efficient in this class of work. Those employed should have had experience with a typewriter. The tabulating system provides something that no previous system ever used by the company has furnished; that is, a check as to the accuracy of individual bills. When a bill is extended incorrectly the error is indicated by the fact that the aggregate amount of bills at the rate in question differs from the amount secured by multiplication of that rate by the aggregate amount of consumption.

The work of reporting connected installations is facilitated by the use of the tabulating system. This makes it possible to secure an analysis, in all connections and disconnections, of the class of business, the reasons for disconnection and the amount of business lost for each reason.

The disconnections can then be classified between removals, changes of name, etc. A record of the installation in kilowatts connected and disconnected on the previous day is reported the following morning to the bookkeeping department, and upon receipt of this the records are made in the customers' ledgers. The reports are then turned over to the operator, who perforates on the card a general description of the transaction in the case of a new connection or of the reason for a discontinuance. At the end of each week a report is made by the tabulating department showing the results of the connections and disconnections each day during the week. A monthly report, showing the connections and disconnections classified according to the service furnished, is also compiled. A monthly report is also made to show an analysis of the connections and disconnections.

In the electric lamp sales and renewal work the lamp tickets are sent to the tabulating department, where the cards are perforated. A daily summary of the tabulating department and a monthly summary of the daily summaries furnish available information as to the lamps handled and amounts of sales, lamps loaned or renewed and the classification of the different kinds of lamps. For the last six months the tabulating system has been used to obtain more quickly and economically the results that were secured formerly by the use of a regular journal for voucher distribution. As the tabulating system proved so effective in the classes of work to which it was applied first, a card was designed next to take care of the weekly payroll charges to the various operating accounts, the various job order numbers and the classification of the expense of teams and automobiles.

A desk was designed by the Baltimore company for the key punch. It is 57 in. by 20 in. by 30 in., with a flat top and a rest for the key punch 5.5 in. below the top.

Discussion.

The paper was discussed by Messrs. C. N. Stannard, Denver; J. H. Donlan, Brooklyn; Y. M. White, Spokane; P. S. Young, Newark, N. J.; L. A. Wallon, Seattle; H. T. Hughes, Denver; H. E. Addenbrooke, Chicago, and E. J. Bowers, Kansas City.

Mr. Stannard voiced the improvement which resulted from the use of machine methods, and Mr. Donlan described the use of the tabulating machine in making inventories of the underground distribution system of the Brooklyn company. About thirty-five forms are employed in connection with the machine, and its success justifies the belief that it will probably be much used for future work. Mr. White stated that about $2,500 per year had been saved at Spokane, the machine being used in connection with balancing card records against customers' records. Messrs. Young, Hughes, Wallon and Bowers emphasized the benefits of the machine in establishing data which could be obtained only with great difficulty in other ways. Describing the use of the machine at Seattle, Mr. Wallon said that four monthly reports are based on its application, one being a report giving the details of residence lighting customers' loads and services, another giving details of business classification, a third summarizing the alternating-current lighting and motor services on the various circuits for the benefit of the operating department, and the fourth analyzing the total lighting and motor services, including extensive customers' data and classifications. The output of the machines is of great value to the operating and sales departments. Mr. Burnett said, in closing, that the tabulating machine is of great assistance in securing data required in connection with commission hearings and that it also keeps executives in touch with the development of the companies' business from day to day as few, if any, other agencies can.

RATE RESEARCH.

The report of the rate research committee, of which Mr. E. W. Lloyd was chairman, reviewed the work done by the committee in 1911 and exhibited progress accomplished in 1912 along the lines of systematic investigation of the general rate problem. The committee found itself unable to reach a unanimous conclusion regarding the desirability of differential rates in residence business, but agreed that either a system which recognizes demand or a straight-line meter rate, with in some cases quantity discounts, is a proper one for small and residence business.

A large amount of valuable special work is being carried on by the committee in connection with the accumulation of information bearing upon the history of rates, court decisions relative to rate regulation, the history of governmental regulation, establishment of definitions, preparation of cases by companies in rate investigations, and the comparison of rates and the factors influencing them under various conditions throughout the country. An office has been maintained lately in Chicago in this connection, and a separate report will be published later in the year as a result of the information gathered. The committee recommended that the systematic arrangement of rate terms and definitions be completed at the earliest date and that the results be referred for approval or criticism to other interested associations, so that eventually there may be established through the association an international code of rate terms and definitions. Since Jan. 17 the committee has issued a weekly bulletin to its member-company assistants, outlining the rate information as received at the office.

The committee concluded that, in addition to the recognition of some general rate-making policy among the member companies, it is very desirable that the actual forms in which the rates are placed before the public should be as nearly alike as possible. The committee agrees unanimously that all large customers should be charged on a schedule making separate and distinct demand and energy charges. The unit charges per kilowatt of annual maximum demand and per kw-hour consumed may be made to decrease respectively with an increase in the number of units of annual maximum demand and the number of units of energy consumed monthly, according to a block system applying to both the demand and the energy charges. By allowing the unit charges to decrease in this way, the equivalent of a customer charge is worked into the rate schedule. For storage-battery charging, refrigeration, etc., lower rates can properly be made. The committee stated that it is for the best interest of the public and the central stations that the rates should permit the free renewal of standard lamps and the offering of other lamps at such low prices as to prevent dealers from competing with inferior lamps. Demand measurements appear impracticable in the cases of very small consumers, the connected load, floor area or number of rooms affording a reasonable basis of rate-making. The committee expressed its approval, for small consumers of commercial lighting or motor service, of either a block rate making separate demand and energy charges, based on electrical demand with a minimum, or a straight line or block rate carrying kilowatt-hour charges only, with a suitable minimum. For small consumers in the residential class, either a two-charge rate based on demand, with a minimum demand estimated on a floor area or room basis, or a straight line or block rate carrying kilowatt-hour charges only, with suitable minimum, is recommended. For very small residences the committee favors a demand rate based on controlled or limited demand. The rest of the report included a list of proposed definitions of terms used in rate discussions, a recommendation that member companies file their rate schedules with the association as soon as possible, and a set of exhaustive recommendations relative to the form and construction of rate schedules.

Discussion.

This paper was discussed by Messrs. H. L. Wallau, Cleveland; Arthur Williams, New York; P. S. Josselyn, Portland, Ore.; J. W. Lieb, Jr., New York; Samuel Insull,

Chicago; Douglass Burnett, Baltimore; J. Graham, Bangor, Maine; P. Junkersfeld, Chicago, Ill.; L. H. Ballard, Los Angeles; E. Douglas, Milwaukee; C. A. Graves, Brooklyn, and S. B. Cushing, Chicago. Mr. Wallau, commenting on the three basic systems of charge recommended by the committee, showed various advantages and disadvantages, and in addition to the two systems of ascertaining the demand of the installation submitted two others, known as the active-room socket-demand system, such as is used in Cleveland, where a percentage of the actual number of sockets is taken, and the demand-indicator basis for residence schedules.

Mr. Williams claimed that the principle of maximum demand as a basis of charging is over-emphasized and that any maximum-indicator system is restrictive, placing a premium upon convenient and decorative lighting and apparatus unless special provision is made for these services. The New York Edison Company's system of rates for the most part does not take into consideration the maximum demand, although the company employs it where it seems best. Most consumers are connected on straight-line meter rate, the simplicity and the directness of which cannot be gainsaid. The speaker saw no reason for the recommendation basing a rate on the floor area or on the number of rooms in a house, claiming that no relation exists between service and the number of rooms. He also suggested that the committee refrain from recommending any particular system of rates. In general practice Mr. Williams said all rates divide themselves into two great classes, one an average rate, very similar to the rate charged on city street railways, and the other a rate in which the consumer pays his proportionate share of the costs of the service.

Mr. Lieb pointed out that the question of rates is not altogether an economic one, but that geographic and political considerations are embraced in the problem. Residence rates, he said, are in just as chaotic condition abroad as they are in this country, and the block system as outlined in the committee's report is nothing more than a maximum-demand system. While the maximum-demand system is the logical avenue of approach in making any analysis of costs, he was of the opinion that once the costs are established an average rate such as obtains in various other commodities should be placed in force.

Mr. Insull maintained that the products of central stations should be sold on a system of rates which are based upon the money invested. No system of averages, he maintained, does this, and inasmuch as the demand for energy controls the investment necessary to supply them, the maximum-demand system is the only logical system to adopt. No one should expect a company to supply energy on a straight-rate system any more than one would expect a railroad to transport a ton of pig iron and a ton of feathers at the same rate. The whole system of rates should be based upon economics and politics should have no weight.

Mr. Ballard showed wherein the political aspect of rates could not be ignored in a community such as Los Angeles, where the referendum and recall are factors. Mr. Graves stated that the Edison Electric Illuminating Company of Brooklyn is about to place in effect a maximum system of charges. On motion of Mr. Williams, the committee was continued for another year.

COMMERCIAL DEPARTMENT WORK.

The committee on the cost of commercial department work, through Mr. E. L. Callahan, chairman, submitted a report emphasizing the importance and value of keeping a complete record of commercial department costs and pointing out the great diversity of opinion existing even among companies endeavoring to maintain such records. Sample forms were presented showing the arrangement and segregation of items bearing upon the cost of commercial administration, among the blanks shown being those of the Susquehanna Railway, Light & Power Company, Pacific Power & Light Company, American Gas & Electric Company and H. M. Byllesby & Company. As a result of a study of these forms and from the personal experience of the committee, a typical form has been prepared covering the principal items of expense attached to commercial department work, arranged on a monthly basis of tabulation. Salaries, office expenses, automobile and livery charges, association dues, periodicals, advertising, free wiring, losses on motor exchanges, connected loads, contracts secured and unit costs are all provided for, the details being sufficiently elastic to meet a variety of conditions. The report also contained an interesting summary of commercial department costs in various-sized cities, including gross revenue, amount of gross increase per dollar of commercial cost, kilowatt equivalent of contracts obtained and cost of development per kilowatt. Extraordinary variations were displayed in these figures. The commercial department cost per kilowatt connected in cities of 25,000 and less population varied from $5 to $8.25 per year; in cities of 25,000 to 100,000 it varied from $1.08 to $8.95; in cities of from 100,000 to 250,000 it varied from $0.94 to $7.70, and in cities having a population of 250,000 and over it varied from $1.36 to $18.10.

The committee concluded that 2 per cent of the gross revenue is not too much to spend in ordinary situations where the commercial department is a factor in the company's progress, nor 4 per cent for quick results where fields are undeveloped or in peculiar situations, as, for instance, where there is strong competition or where the department spends much time in public-policy and complaint work. Money spent for such purposes will be returned many times over in profitable revenue and good-will. The committee is of the opinion that in most cases if from 2 per cent to 25 per cent of the gross revenue were spent in commercial-department work, for each dollar so expended there might be expected an increase of $4 in gross revenue. The number of solicitors required, as determined from returns submitted to the committee, varies from one solicitor to 10,000 inhabitants in cities of 25,000 and less to one solicitor per 25,000 inhabitants in cities having a population of over 250,000.

CONTRACT-ORDER ROUTINE.

The committee on contract order routine, Mr. T. I. Jones chairman, presented a fifty-two-page report dealing with the practical handling of contract-order routine on the multiple-order basis and giving a thorough interpretation of the procedure deemed desirable after a protracted study of prevailing practice in the larger central-station organizations.

The fundamental purpose of the committee has been to suggest a routine involving the least amount of work with a minimum delay. Within the past few years nearly every large central station has had this matter under consideration, and the result of the ideas tried out by the larger companies is embodied in the report. The routine is confined specially to the sales, credit and installation activities, leaving the work of the meter, billing and auditing departments for further inquiry. The committee feels that a general tendency exists to keep too many records, and it has worked hard to reduce the amount of these to the minimum.

The report emphasized the desirability of acknowledging applications by telephone, with subsequent confirming letter; the tendency to require salesmen to handle too much clerical work; the desirability of maintaining a liberal policy regarding deposits; the benefits of the multiple-order system, notably as a time-saver; the advantage of employing a night force until about 10 p. m. daily to handle the preparation of orders on the day the application is received; the methods of following up work in progress, giving advice to customers and handling of disconnections.

Cut-offs by collectors for non-payment have been found highly economical and efficacious from the moral point of view. In handling the multiple-order program a multigraph machine capable of producing 100 impressions of an order is of the greatest desirability, although in many cases only a few copies of an order are required. In Chicago, where thirteen copies of an order are made, it has been found that fifty complete copies may be made, joined together and assorted for distribution in one hour from the time the order is delivered to the typist for the hectograph original.

A striking feature of the report is a synopsis of operations in the suggested connection order routine, as follows: First, the salesman signs the application and makes out the detailed report; second, the salesman turns it in to the office on the day the application is received; third, the application is checked for accuracy by the chief clerk; fourth, all orders connected with the execution of the work involved in the application are made out on the day of application by the multiple-order clerk of the sales department; fifth, all orders are forwarded on the same day to the department passing on the credit; sixth, this department, after approving the applicant's credit, forwards the orders to the departments affected and acknowledges the receipt of the order; seventh, the records of work in progress are kept by the departments requiring the closest touch with the order's progress in order to facilitate prompt connection; eighth, all multiples of order showing completed work are returned to the department keeping the records; ninth, a letter of notification is sent to the customer on the completion of the work, embodying a synopsis of all company forms of contract and suggesting various uses of electricity.

The remainder of the report dealt with the details of connection routine, disposition of copies of orders issued, work of salesmen, typical order and routine forms used by the large companies in Boston, Brooklyn, Philadelphia, New York and elsewhere. The material prepared by the committee forms a working system ready for immediate application on a large scale with such minor changes as local conditions require and constitutes a valuable contribution to the literature of office routine.

Discussion.

The report was discussed by Messrs. J. F. Davidson, Portland, Ore.; Douglass Burnett, Baltimore; C. N. Stannard, Denver; William H. Hodge, Chicago; M. C. Osborn, Spokane; H. Goodwin, Philadelphia; T. I. Jones, Brooklyn, and Arthur Williams, New York. Mr. Davidson complimented the committee on the value of its report, although he deplored the lack of co-operation on the part of some central stations, which had detracted from its completeness. The new-business and soliciting idea, he pointed out, is still new, and much experimental effort has, of course, been wasted in the earlier attempts, although now commercial work must be definite and effective.

Mr. Burnett said that from 75 to 85 per cent of all orders entered at Baltimore are completed in forty-eight hours, including necessary line extensions. Mr. Stannard declared it unnecessary that more than twenty-four hours elapse between the filing of a connection order and its completion. At Denver, he said, all orders received before 10:30 a. m. are connected up that afternoon, and all before 4:30 p. m. are connected up the next morning. These figures do not include, of course, cases where pole construction is necessary, although the average for making such extensions is less than three days.

Mr. Hodge recommended the appointment of a committee on central-station advertising and publicity to make a scientific investigation of methods and expenditures required in these departments, pointing out that more than 50 per cent of the new-business outlay made by central stations is expended for advertising. Mr. Osborn insisted that the number of salesmen required should depend on their individual ability and not on any definite ratio of business to be handled. Mr. Goodwin pointed out objections to the practice of having salesmen check location and carrying capacity of conductors to reach customers' premises, insisting that serious blunders might be made unless such information is secured directly from the engineering department. Mr. Jones repeated an earlier statement that members of the new-business staff should be called "salesmen" and not "solicitors," since the first implies success, he said, and the latter ineffective effort. The Brooklyn company recently undertook a campaign of service inspection and found this to result beneficially not only to the service and in the attitude of its customers but also in the increase in its appliance business noted immediately after. Mr. Williams spoke of the appreciation in which members should hold the work of the committee.

Miscellaneous.

TERMINOLOGY.

The report of the committee on terminology was presented by Chairman W. H. Gardiner and was confined to the definition of terms pertaining exclusively to central-station business. Certain terms and definitions relating especially to accounting were left to the committee on uniform accounting, but certain definitions adopted by the rate research committee were included in the report. Among the terms defined were "capacity," "demand," "load factor" and "diversity factor." The term "watt-hour meter," as applied to an instrument registering watt-hours, was recommended in place of the incorrect terms, such as "integrating watt-meter" or "recording watt-meter," now often employed. The definitions presented by the rate research committee cover such terms as "flat rate," "demand rate," "meter rate," "two-charge rate," and a number of similar terms.

Discussion.

The paper was very briefly discussed by Mr. L. M. Peart, Fresno, Cal. In general, the definitions of new terms submitted by the committee met with the approval of those present and no prolonged discussion took place.

STEAM HEATING.

A forty-nine-page report was presented by the committee on steam heating, of which Mr. S. Morgan Bushnell was chairman. It contained the results of centralized practice in commercial heating by about 100 companies, diagrams showing the fuel requirements of department stores on typical winter days and contract forms used by heating organizations. There are about 250 heating companies in the United States at present. The committee finds that many of these are not directly profitable. In many cases where profits are claimed no proper separation of costs has been made. Even where costs are separated, depreciation is seldom included. Overhead expenses are often charged entirely to the electrical division. Rates should cover all costs. Depreciation is high in distribution systems and no allowance should be made for the value of electricity generated in connection with exhaust steam heating, as the growth of business is almost certain to force the use of live steam at a later period. Meter rates are desirable from all points of view, even though the equipment for steam measurements needs much improvement.

Decentralized steam plants appear to have a field, notably in large cities in connection with isolated plant competition. The New York Steam Company reports that the average building uses 25 per cent less steam where meter rates are used. A fair service charge appears to be from 15 cents to 20 cents per sq. ft. of radiating surface per

heating season, combined wtih a meter rate of about 30 cents per 1000 lb. condensed; or, in other words, a fair price might be taken as 60 cents per 1000 lb. condensed. This rate is higher than that secured by the average heating company, but the committee feels that charges for such service can be raised somewhat without detriment. Before any company determines a price, a careful estimate should be made of the total cost, including the cost of steam production in the plant, the cost of steam distribution, the cost of handling the business, including salesmen, collectors, etc., the general office expenses, insurance, taxes, interest, depreciation and obsolescence. Among the interesting points mentioned in the report were data prepared by Mr. D. S. Boyden, of Boston, which showed that if an isolated plant had been installed in a representative Boston department store a considerable amount of live steam would be required for heating and also a large amount of exhaust steam would be wasted during the day and evening. In a Chicago building of the same sort it was shown that in order to operate an independent plant in the building for electrical requirements about 88 per cent more coal would be required. The committee concluded that the steam-heating industry is now passing through a period when the balance is largely on the wrong side of the ledger, but that the future will doubtless witness improvements in equipment and methods which will result in genuine profits. Data regarding prices were included from about twenty states.

Discussion.

The report of the committee on steam heating was read by Mr. A. D. Spencer, of Detroit, in the absence of Chairman S. M. Bushnell. Mr. E. W. Lloyd, of Chicago, said that his company finds the meter basis superior to flat rates from the standpoints of satisfaction to both the customers and the central station, as well as the elimination of waste. A winter like the last, he remarked, might prove serious to a company selling steam heating on a flat rate. In closing Mr. Lloyd advised any company going into the steam-heating business to secure first all possible information concerning its own costs and to employ the meter schedule of charging. Mr. R. E. Wolff, of Rochester, N. Y., declared that charge should be based on pounds of steam condensed per hour instead of on the square feet of radiation surface. The use of recording thermometers, he said, has resulted in marked economy of steam, doubtless in part through the interest taken by the customers in adjusting their valves. Mr. T. I. Jones, of Brooklyn, N. Y., declared that, admitting steam-heating service to be a necessary evil, as all companies, he said, find it to be after experience, it is a question whether this service should be sold for profit or conducted at a loss to secure and hold other desirable business. Results derived from formulas, he insisted, often miss the actual values by 30 per cent. In other cases customers have required twice the quantity of steam estimated. No portable meter is yet available that can be set up and used for temporary test installation except on long runs after complete calibration. The flat rate for steam, declared Mr. Jones, is fallacious and really amounts to guesswork. If a company must sell steam, he repeated, by all means secure full cost data and employ a meter basis.

Mr. Egbert Douglas, of Milwaukee, remarked that the steam-heating system in that city is one of the most elaborate and complete ever installed. It includes two miles of 8-ft. tunnels, containing small pipes which can be replaced without serious expense. The Milwaukee steam system is required to pay its own way, but thus far, not having been pushed, has not been profitable. Mr. Douglas declared it meaningless to sell steam on a basis of square foot of radiation area, advising instead the cubical volume schedule. The waste incurred in flat-rate systems is shown where changes have taken place to the metered basis. In several cases customers' bills jumped to four times the former amount, but this was remedied subsequently. The Milwaukee company does not recommend turning off individual radiators, advising instead that the main service valves be shut to control the economical heating of buildings. In the case of one hotel mentioned it was found that the cost of heating the water was greater than that of heating the building itself, since the entire quantity of water used was unnecessarily heated to 180 deg. Small heaters operating at different limiting temperatures solved this difficulty. In closing, Mr. Douglas said it is waste that makes steam service unsuccessful where there is no incentive to economize.

Mr. F. W. Hild, of Portland, Ore., asked whether heating plants operated in separate buildings are ordinarily connected by common mains to secure diversity between the mains. Mr. F. A. Bryan, of South Bend, Ind., asked for practical confirmation of the claims made by heating-system promoters that customers will pay more for district heating service than for isolated-plant service.

Mr. Ludwig Kemper, Albert Lea, Minn., inquired whether the exhaust from internal-combustion engines has been used practically for heating service in this country. While it is often the practice for central-station companies to operate engines in old isolated heating plants on their systems, Mr. P. Junkersfeld, Chicago, inquired whether this would be advisable in the case of a new building. Mr. W. H. Lyons, of Portland, Ore., declared that the cost of steam heating commonly receives much consideration. An isolated plant, for example, which ran only during the winter, the lighting at other times being purchased through the central station, was shown to generate only 16 per cent of the total energy used during the year, thus indicating that only 16 per cent of the fuel consumed by a similar steam plant should be credited to heating. In addition, large demands of live steam are invariably required to heat buildings in the morning hours.

Mr. Rufus E. Lee, Clarinda, Ia., asked whether it is the practice to install separate meters in small buildings where several customers are served. One of his customers rented a second story to tenants, whereupon the total cost of the service instantly increased to twice the former amount. The charge was divided between the customers on a radiation-ratio basis, but the increase occasioned vigorous objections from the first consumer. Mr. J. A. Britton, San Francisco, Cal., remarked that the company which has a steam-heating system is like a man holding a bear by the tail; it is inconvenient to hold on and dangerous to let go. To companies about to install district heating he gave *Punch's* pointed advice, "Don't!" Half as much effort as is required to pacify heating customers, if properly devoted to commercial efforts, he said, would leave a large balance on the profit side of the ledger. In closing the discussion, Mr. A. D. Spencer admitted that meters often show large variations of the values indicated by theoretical formulas. While meter service is desirable, the accuracy of present steam and condensation meters is doubtful and the cost of maintaining them large. He stated that customers should be willing to pay 25 per cent more for district service over isolated-plant heating on account of the convenience of the service and the saving of rental of space, damage to goods, lack of responsibility, etc.

ELECTRICAL INSURANCE.

The report of the insurance expert of the association, Mr. W. H. Blood, Jr., presented by him, covered the progress made during the past year in a very concise manner. It is gratifying to note that fire underwriters are giving more attention than formerly to the scientific rating of central stations, and that the operating companies, in turn, are observing the underwriters' requirements more carefully. Liability insurance is yet in the embryo state, but reference was made to the provisions of the new workmen's compensation law in the State of Washington. The work of the committee on grounding

secondaries was also mentioned; this is reported elsewhere. The new specifications for rubber-covered wire have only recently become effective, and it is too soon to judge the results. Mr. Blood stated that his assistance is asked for many times each year, but too frequently the request is not made soon enough. This can obviously be remedied.

PROGRESS REPORT.

The report of the committee on progress, by Mr. T. C. Martin, executive secretary of the National Electric Light Association, was divided into two parts, the first dealing with general progress and the second with energy transmission. Part I comprised a pamphlet of 120 pages, which dealt with all the important advances in the central-station industry during the year just closed. The opening section was devoted to general growth, and exhibited a total of 6406 central stations in the United States, Canada, Mexico and the American possessions on April 1, 1912. The next section, on foreign comparisons, shows that the United States is far in the lead in central-station development. Sixteen pages were devoted to government regulation and rates. The new commissions added during the year were those in California and Ohio. The results of commission rule were reported as on the whole very favorable, and a number of the more important cases decided within the past year were briefly discussed. Municipal ownership was mentioned as reviving in popular favor, notwithstanding unfavorable experiences in England and in a number of American cities, including Milwaukee, Wis.; Galveston, Tex.; Cleveland, Ohio; Napanee, Ontario, and Winnipeg, Manitoba. Private competition from isolated plants of course continues, but central station companies as a whole are constantly giving the problem more attention, with gratifying results.

A section on new stations and plants occupied fifteen pages. Turbo-generator units have now reached 20,000 kw in individual ratings, and a unit of 25,000 kw is being built. The under-water storage of coal is being adopted on account of its safety and economy. Lignite producer gas, natural gas and oil-burning plants were also briefly mentioned. The report included a comprehensive section on illumination, dealing both with street and interior lighting in Europe and America and with new types of lighting units. The recent attention given to securing rural business came in for considerable comment, as did also a variety of other uses for electric energy, including electric vehicles, irrigation and general pumping, ice and refrigeration plants, heating and cooking. In reference to the last-named use, a very interesting table was presented which shows the cost of electric cooking for an average family for a period of eight days. The next section dealt with general relations with customers, some of the topics being the ratio of customers to population, wiring campaigns and the contractor, the best means of interesting and instructing customers, free fan service for the sick and the advantages of attractive office buildings. The report closed with a section devoted to relations with employees, which includes a reference to the work of the committee on resuscitation from electric shock.

EXPANDED LOYALTY.

Mr. Paul Lupke's contributions to the association list of papers have a flavor of their own, and this year's is no exception. Under the title "Expanded Loyalty," the author set forth in a heart-to-heart fashion the value of fidelity to the industry, the influence of doing more than one is paid for in attaining larger success, and the evils of "knocking" the institutions with which one is connected. Honesty, ability to carry out assigned duties and willingness to undertake extra work are vital factors in the personal progress of the employee. "Loyalty to your employer means a step out of your way whenever that step is necessary to conserve his interest. There are occasions when the sacrifice of a few minutes of your own time may save the company as much as your regular time is worth for several years. You are not loyal if you do not make that sacrifice," said Mr. Lupke. "Every one of us has opportunity to discourage untrue, exaggerated or unfair statements concerning the central-station industry; let him use his opportunity consistently, firmly, with discretion. Be careful in your dealings to give full credit where it properly belongs and stand up like a man for any reputable fellow-employee who seems to suffer through misrepresentation. Endeavor with all your might to eliminate the gall of misunderstanding that injects the bitterness into the endless strife that seems to be our lot." Concluding, the author advocated the drawing up of a code of rules for the central-station industry corresponding to the "Code of Principles of Professional Conduct" recently adopted by the American Institute of Electrical Engineers.

EDUCATING CENTRAL-STATION EMPLOYEES.

In a paper by Mr. H. E. Grant a strong plea was made for the education of men and women for larger service in the central-station industry. The author touched upon the value of periodicals, conventions and courses of study in the production of better workers. Special efforts should be made by central stations so to train their employees that each will intuitively do the right thing at the right time. Low operating cost is not a function of cheap labor in the industry under consideration. Billing work should be handled by properly qualified accountants, reducing the cost of billing and the number of errors and customers' complaints. Education must necessarily be somewhat experimental, but with efficient supervision, regular meetings of the staff, the development of company sections and, so far as practicable, the organization of systematic study, successful training will be furthered. No company is so small that it cannot support its own bulletin. Lectures by successful men and women are also helpful. The paper concluded with an appendix describing in detail the commercial school work of the New York Edison Company, which includes courses in the elements of central-station business getting, hygiene, health, recreation, psychology, basic principles of salesmanship, and the scope, policies and organization of the company.

Discussion.

The paper was discussed by Messrs. T. F. Bludworth, New York; C. N. Stannard, Denver; V. L. Board, Denver; C. A. Graves, Brooklyn; W. H. Gardner, New York, and Arthur Williams, New York. Mr. Bludworth compared man to a tree, extending the analogy to show how the human must be adapted to the conditions of his employment and the industry in which he works in order to attain his best growth. Mr. Stannard said that, after correspondence with many companies, he had been surprised at the little being done by only a few companies in educating their employees. The work being carried out by the New York company he declared to be very exceptional. Several other companies, in order to give deserving men opportunities for an education, pay the cost of the tuition fees and in other cases allow a man every second afternoon off for technical-school work. Mr. Stannard declared himself to be a believer in employing educated men wherever possible, although lack of education, he added, would not be a reason for refusing to give a man a chance.

Mr. Board explained the advantages of shifting a new man about from one department to another when possible, so that he becomes acquainted in this way with each of the departments associated with the one in which he is to work later. The Denver company has a two-year-contract cadet-engineer system. The Telluride Institute at Ohmstead, Utah, said Mr. Board, is a technical institution maintained by one of the officials of the Telluride Power Company for the education of deserving and ambitious em-

ployees. Those showing exceptional abilities receive scholarships so that all of their time may be devoted to school work. In undertaking the uplift of employees Mr. Learned insisted that physical training should not be overlooked, since the physical being is the foundation on which the brain works. The North Shore Electric Company at Chicago, he explained, pays one-half of the gymnasium fees to encourage employees in taking physical exercise.

Mr. Graves said that central-station men as an average aim too high. In taking school work, he found such men to be very willing to hear lectures and do experiments, but they failed completely when required to pass examinations. He recommended simpler and more practical aims. Mr. Gardiner said that in the French and Italian languages a distinction is made between "instruction" and "education," a difference which might be properly extended to our own tongue and usage. It is important that the company teach the man to live properly, to think properly and to act properly, and to show the employee how he can do his best work. Mr. Gardiner recommended that a committee be appointed on the education and instruction of employees.

Mr. Williams insisted that no industry has done so much to help its employees, both technically and broadly, as the central stations. A man, said Mr. Williams, is the product of heredity, environment and education, and even under the third heading much can be accomplished with unpromising material. A large selling company found that it could not secure enough "born salesmen" to meet its needs, so it undertook with success the feat of educating average men up to its purposes. The most successful man, concluded Mr. Williams, will be the one who has the broadest education and general information.

SOME USES OF METALS.

In a paper by Dr. W. R. Whitney, director of the research laboratory of the General Electric Company at Schenectady, N. Y., were sketched the latest metallurgical advances which are of interest to the electrical industry, emphasizing the useful materials which have been formed in the alloy field and showing the mutual benefits enjoyed by the electrical art and new metal substances. He paid a high tribute to the German method of scientific research, by which applied science reaps the benefit of painstaking investigations conducted in the philosophical spirit. As an art advances it requires greater and greater knowledge to make substantial improvements in it.

Taking up specific metals, the writer pointed out that improvements in electrolytic refining methods have resulted in the production of practically pure copper. Impurities are fatal to the efficient use of this metal in electrical applications. The introduction of 0.1 per cent of arsenic in copper raises the I^2R loss 30 per cent. This would correspond to an increased capitalization of $20,000,000 per year in copper for the apparatus manufactured by the General Electric Company alone. Hardening agents increase the resistivity of copper to a prohibitive degree. By the use of boron copper may be cast of high conductivity, high density and freedom from blow-holes. As squirrel-cage types of rotors are already cast in place after the iron is assembled, other innovations are to be expected along this line.

Heavy castings, resistance grids, tool steels and many other materials used in the electrical industry require special grades of iron. The use of tungsten and chromium in tool steel has practically quadrupled the weight of chips which can be cut in a lathe in a given time. There are now at least 125 high-grade electric steel furnaces in operation in Europe and America. Titanium, chromium, vanadium, molybdenum, thorium, uranium and zirconium are all finding useful places in the manufacturing field. Alloys of chromium with iron, nickel and manganese have superseded most other resistance material for heating devices, rheostats, etc. The possibilities of alloys of which iron is the chief constituent appear almost limitless in the electrical field. The entire industry is now tied to the silicon-iron alloy. The highest grade transformers now utilize an alloy of about 4 per cent silicon, having a high resistivity and low eddy-current and hysteretic energy losses. If the cores of the transformers sold by the author's company had all contained the high-grade common iron used in the case, the loss last year would correspond to about $15,000 per day more than is entailed by the use of the silicon alloy, assuming a 10-cent rate per kw-hr. In closing, Dr. Whitney discussed the improvements due to the electric furnace, and particularly to the vacuum type, in research work, emphasizing the deeper study now possible of melting points and other properties of alloys and refractory materials. Such researches bear directly upon electric heating and cooking progress and are of great value in the manufacture of modern lighting equipment. Tungsten in particular is finding a broader sphere of usefulness in consequence of the electrical laboratory and its investigations.

Discussion.

The paper was discussed by Messrs. Charles W. Stone, Schenectady, and C. E. Bogardus, Seattle, Wash. The latter pointed out the desirability of placing in the hands of prospectors samples of high-priced ores so that they might recognize them in their work and have some comprehension of their uses and value. Mr. Stone told of many improvements in apparatus attributable to modern research in metallurgy.

PROPOSED COMPANY SECTION LECTURE BUREAU.

Before a meeting of the company-section representatives Secretary T. C. Martin outlined his plan for an association bureau to furnish valuable lecture features for company sections with the aid of manufacturers who are members of the association. After the first burst of enthusiasm following the organization of a company section, said Secretary Martin, it is often found difficult to maintain the level of interest. Local sections usually lack the talent to present continuously papers of a high order of interest and value, nor can they afford the expense of securing capable outside lecturers. The intended purpose of the lecture bureau, therefore, is the supply of lectures and lecturers for regular programs or to supplement local efforts. To this end each Class D member of the association would be invited to prepare a lecture on some new apparatus, invention or problem with which it is concerned, care being taken to secure as the author the best equipped man available in the member company's organization. Such material should be so arranged as to leave its advertising features inferential rather than obvious.

The lectures might be delivered by their authors where convenient, by local representatives of the company or by other speakers, as might be designated. Lantern slides would add to the interest and value of the talks, the sections bearing the expense of the lanterns. The entire bureau, if organized, should be under the control of the secretary of the association, the material of the lectures being preserved exclusively for the use of section lectures. Permission to publish could be given to the press, however, in the case of brief abstracts which would not affect the news value of the matter for lecture work. By subjecting the lectures to the censorship of a committee, their subject matter could be kept up to the high standard of quality desired. The cost of operating such a bureau would be from $1,000 to $1,500 per year. Mr. Martin said that he had communicated his plans to a number of those interested in section work as well as to representatives of the larger manufacturers, and all to whom the subject had been mentioned expressed the greatest satisfaction and desire to co-operate. Mr. Martin cited the names of a number of leaders of the industry who have offered their own time and services for the purposes of the lecture bureau, mentioning among the number Mr. Edison, Prof. Elihu Thomson and Mr. H. L. Doherty.

DEVELOPMENTS ON SPOKANE RIVER, WASH.

Hydroelectric System of the Washington Water Power Company on the Spokane River at Little Falls and Long Lake, Completed or Now Under Way.

Highest Spillway Dam in the World Being Erected at Long Lake, Impounding Body of Water 23 Miles Long—Huge Waterwheels Rated at 22,500 hp Each—High Joint-Station Efficiency at Little Falls—Energy Transmitted at 60,000 Volts to Spokane and Mining Regions.

THE Washington Water Power Company supplies electrical energy for lighting and other purposes in Spokane, Wash., as well as for all the towns and cities in the Inland Empire within a territory extending approximately 100 miles east, west, north and south of that city. It has 534 miles of 60,000-volt transmission line, two sections of which feed the Cœur d'Alene mining district in Idaho, the biggest producing lead-mining center in the world. From Spokane, Wash., to Wallace, Idaho, two independent lines traversing different routes carry the electrical energy to the center of the lead-mining district, nearly 100 miles east of its point of generation. This Cœur d'Alene camp alone is said to produce more than one-third of the lead output of the United States.

Another high-tension line extends south for nearly 65 miles into the fruit-raising Palouse country, one of the greatest wheat belts in the Northwest. From this line the towns along the route are lighted, the flour mills operated and electricity is distributed for general use. Still another line extends 117 miles into the Big Bend country contiguous to the Columbia River, where is a rich fruit-growing and wheat-raising addition to the older Palouse country. The line to the north extends as far as Newport in the lumber region, traversing also a part of the State of Idaho. In Spokane the energy is distributed for the operation of over 24 miles of interurban electric railways and 88 miles of city lines, the company's street-railway system being the largest in the city and its two interurban lines connecting Spokane with Cheney and Medical Lake. The Great Northern shops are among the many industrial establishments supplied in Spokane from its circuits. The company has also splendid municipal and commercial lighting loads, for gas is not used to a material extent in Spokane for lighting, and there is no competition.

Fig. 1—Hydroelectric Station of Washington Water Power Company at Little Falls, Wash.

All the generating stations of the Washington Water Power Company are located on the Spokane River, there being in operation at the present time three water-power plants and a single steam station. Another hydroelectric development is now under construction at Long Lake, which is unique in many ways and which when completed will be the largest station of the company. The steam-

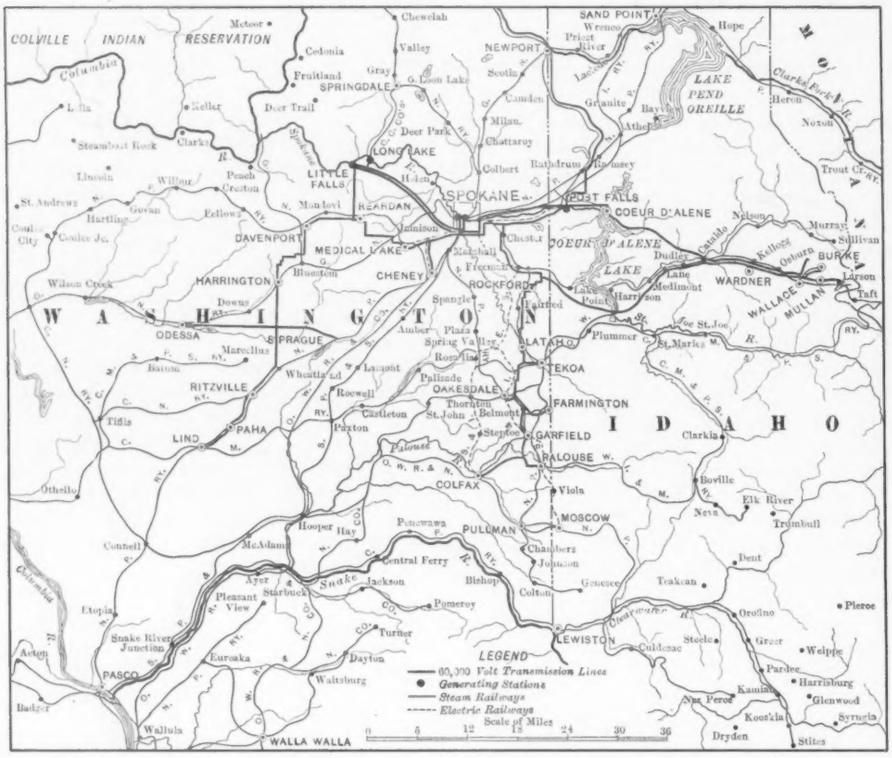


Fig. 2—Map Showing Territory Covered by Washington Water Power Company's Lines.

turbine station in the city is rarely operated, excepting in emergencies. Some years it has hardly been operated at all. Three months is much more than the average use. On the lower falls of the Spokane River, in the heart of the city, is the original development of the company, with an output of 8750 kw. The head available at the lower falls is 70 ft., and the station will eventually give place to one of more modern pretensions whose construction will in general outline follow that of some of the notable plants at Niagara. The new station will use the potential energy of both the lower and the adjoining upper falls of the river, whose aggregate drop is 144 ft.; for at the present time the Washington Water Power Company is only developing a fraction of the power available in the river at Spokane.

Twenty-four miles up the river at Post Falls, Idaho, there is a hydroelectric station capable of generating 11,250 kw. The largest plant at present in operation is located at Little Falls, Wash., where 20,500 kw is installed. The Long Lake station, work on which is now in progress, is located a few miles above that at Little Falls and will have a maximum output of 62,000 kw.

The developments of the Washington Water Power Company are among the largest in the Northwest and the system as a whole is one of the finest in the country. The waters of the Spokane are used four times between Post Falls and Little Falls, and in order that a comprehensive view of the hydroelectric system may be had it may be well to trace briefly the course of the river from its source to below the Little Falls station.

Among the foothills of the Bitter Root Mountains in the western part of Idaho is Lake Cœur d'Alene, 45 square miles in area and 2120 ft. above sea level. The lake is fed by the Cœur d'Alene and St. Joe Rivers, and it in turn gives rise to the Spokane River, for which it acts as an immense reservoir. Ten miles from the outlet of the lake on the Spokane River is Post Falls, 24 miles east of the city of Spokane, where the controlling works are located. At that point the river has cut its way through three channels, affording a head of 50 ft. The station is built across the middle channel while the north and south channels are also dammed. By this means the maximum storage of water to a depth of 6.5 ft. in Lake Cœur d'Alene is obtained and the river itself made navigable from Post Falls to its source. The south channel has a dam 78 ft. long, provided with six sliding gates and a 42-ft. spillway. The north channel contains the principal controlling works, comprising seven Tainter gate sluiceways, one log sluice and a 110-ft. main sluiceway fitted with two bear-trap dams. During the spring when high water prevails the Tainter gates, bear-traps and sluiceways are kept open for a period of about three months. It will be evident, therefore, that the flow in the Spokane River, except as it is increased by streams farther down, may be controlled within certain limits from Post Falls, Idaho. Moreover, it is possible to augment the normal flow if necessary by drawing down the level of Lake Cœur d'Alene.

The next hydroelectric development is located within the heart of the city of Spokane, where, as stated previously, the original hydroelectric station of the company is located. Continuing down the river, the steam-turbine station is passed at Ross Park and the next development is found at Long Lake 24 miles in an air line west of Spokane and about 4.5 miles up-stream from the recently completed sta-

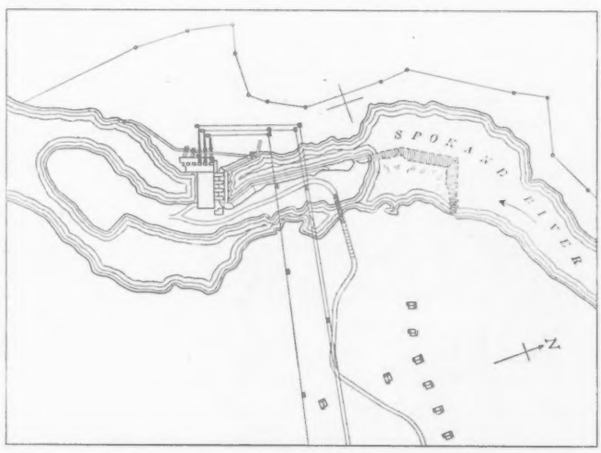


Fig. 3—Little Falls Development of Washington Water Power Co.

tion at Little Falls on the same river. The dam to be erected here and described further on in this article will create a lake 23 miles long having an average width of three-eighths of a mile. Stability is assured to these various developments by the natural reservoir of Lake Cœur d'Alene and again by the immense body of water impounded by the dam at Long Lake. It will be understood,

of course, that more water is available at the Long Lake and Little Falls stations than at the Post Falls and Spokane stations owing to the acquisition of water from the Little Spokane River and other streams emptying into the Spokane below the city.

LITTLE FALLS STATION.

Since May 23-30, 1908, when we published an account of the station of the Washington Water Power Company at Post Falls, Idaho, then just completed, the growth of the city of Spokane and of the territory surrounding it has been so rapid that large additional power resources have been required. The company has just completed the construction of its plant at Little Falls, located about 30 miles west of Spokane and comprising four generating units each of 5550-kva rated capacity.

THE DAM.

The dam is built of so-called cyclopean concrete construction, about 20 per cent being of granite rock quarried from the forebay. This rock was treated in the usual manner and bonded with a concrete mixture in the proportion of 1-3-6. The dam has a maximum width at the base of its spillway of 53 ft. 4 in. and a maximum height of 64 ft. The entire retaining structure contains about 55,000 cu. yd. of concrete.

The spillway is of the ogee section, 604 ft. long. The buttress wall rises 7 ft. above the spillway and is 813 ft. long. The headgate structure is 131 ft. long and the west abutment is 168 ft. long, making the total length of the retaining wall 1716 ft. Two hand-operated relief gates of the inverse Tainter type with a sill 20 ft. wide and 15 ft. below the crest of the dam provide amply for the low-water discharge of the river. At the junction of the spillway and the forebay wall is fastened a heavy log boom which rises and falls with the river and keeps the forebay free from all floatage. The present dam affords a 73-ft. head. In order to comply with the government regulations, a log chute was constructed, as well as a fishway.

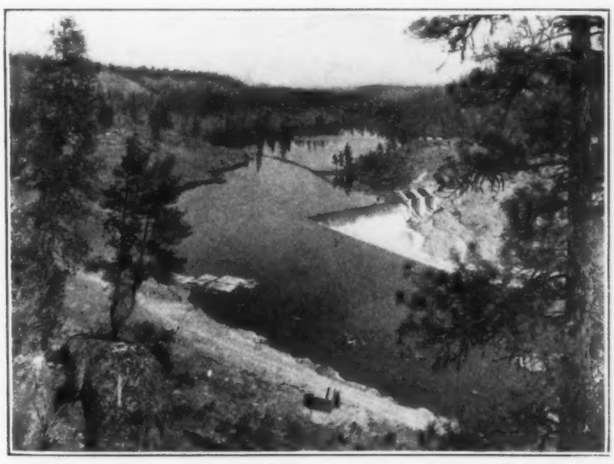


Fig. 4—Forebay and Portion of Lake, Little Falls Station.

Trash-racks at the forebay side of the headgates provide for keeping floating material from entering the turbines. The penstocks are closed by headgates bearing on rollers and kept watertight by a continuous leather strip. Each gate is operated by 20-hp, 250-volt series-wound motor, the drum controllers for which are located in front of the station service board. Limiting devices attached to the rack of each headgate open the motor circuit at each end of the travel so that the controller drum must be reversed in order that the motor may be operated again. Energy for operating the headgate motors may be taken either from the exciters or from the storage battery. It is possible to close the gates in 45 seconds, and each headgate is provided with a small hand-operated filler gate for filling the penstock and thereby equalizing the pressure on both sides of the gate before raising.

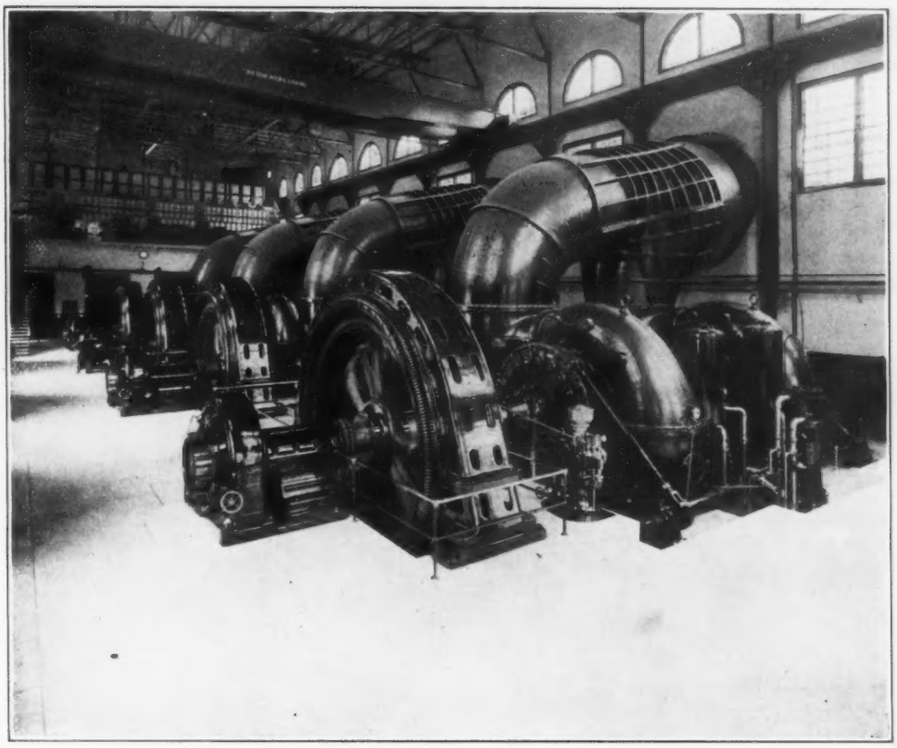


Fig. 5—Interior of Little Falls Station of Washington Water Power Company.

THE POWER HOUSE.

The power house as well as the dam rests on solid rock. It is of reinforced concrete and fireproof throughout and is L-shaped in plan. The generator room is spanned by a 50-ton electrically operated Niles crane, having an auxiliary hoist of 25 tons. Its travel is from the east end of the station to the switchboard gallery, and the latter has an extension on the north (forebay) end, to and from which the crane may handle material. The crane motor is supplied with direct-current energy at a potential of 250 volts.

The water is carried from the forebay to the turbines in a steel penstock 75 ft. long and tapering from 16 ft. of the intake to 14 ft. 10 in. at the turbine casing. Just outside of the power house the penstock is connected to a 3-ft. bleeder pipe through a 24-in. valve. Because of the short length of the penstock no standpipe was necessary.

THE TURBINES.

The waterwheels built by the I. P. Morris Company develop a maximum of 11,000 hp each, under a head of 73 ft. Each turbine consists of a pair of bronze runners 74 in. in diameter mounted upon a horizontal shaft within cast-iron scroll casings and discharging centrally into a common draft chest. The water enters the runners from the

casings through movable steel guide vanes which are actuated by a governor through an external shifting ring. The wheels are so arranged that all moving parts may be externally lubricated, and aside from the guide vanes, runners and shaft no movable parts are submerged.

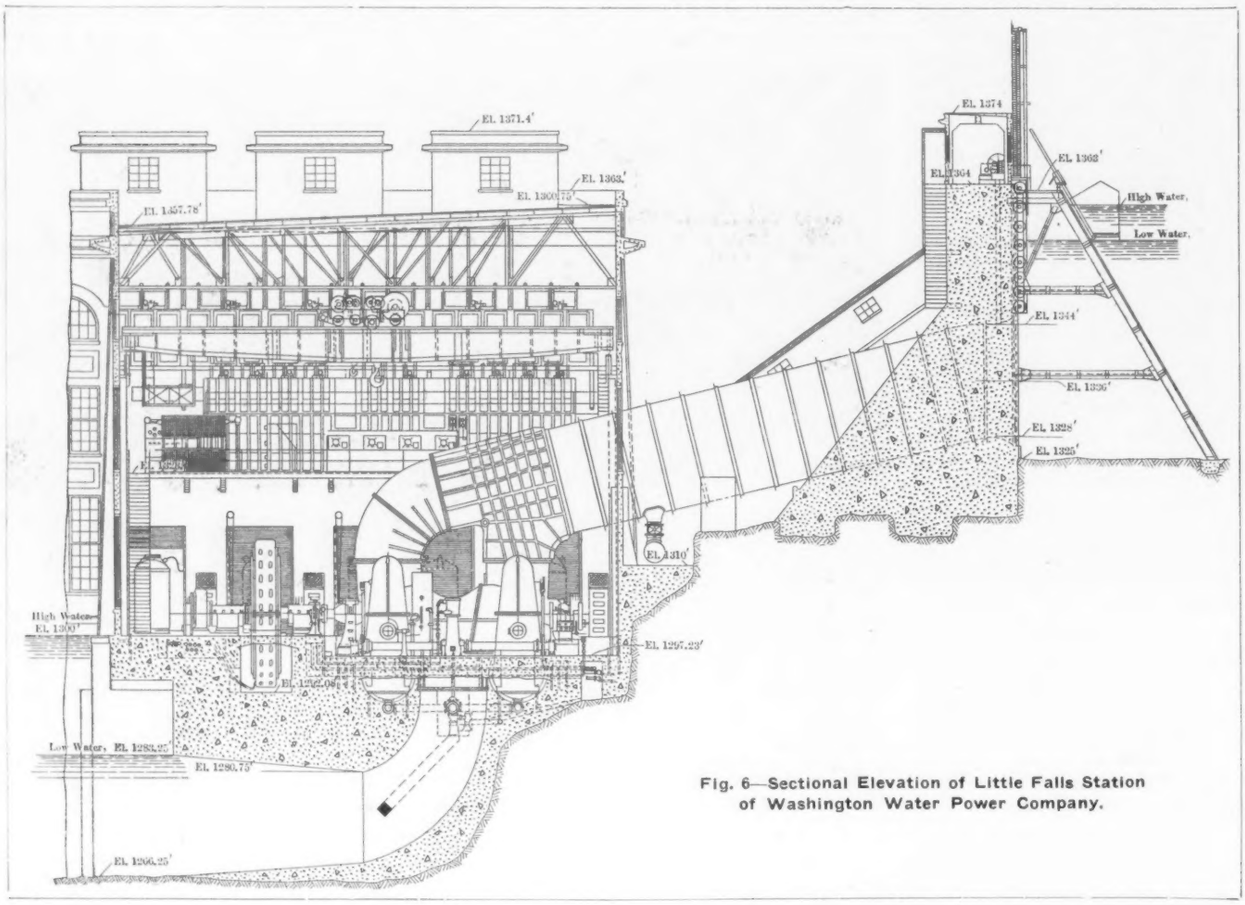


Fig. 6—Sectional Elevation of Little Falls Station of Washington Water Power Company.

of brass. Each main unit is provided with a hand-operated friction brake.

ELECTRIC GENERATORS.

The generators built by the General Electric Company are of the alternating-current, revolving-field type wound for three-phase, 60-cycle, 4000-volt service and running at a speed of 150 r.p.m. The generator is connected to the turbine with a flange coupling forged solid upon the shaft. The windings are connected in star with the neutral un-

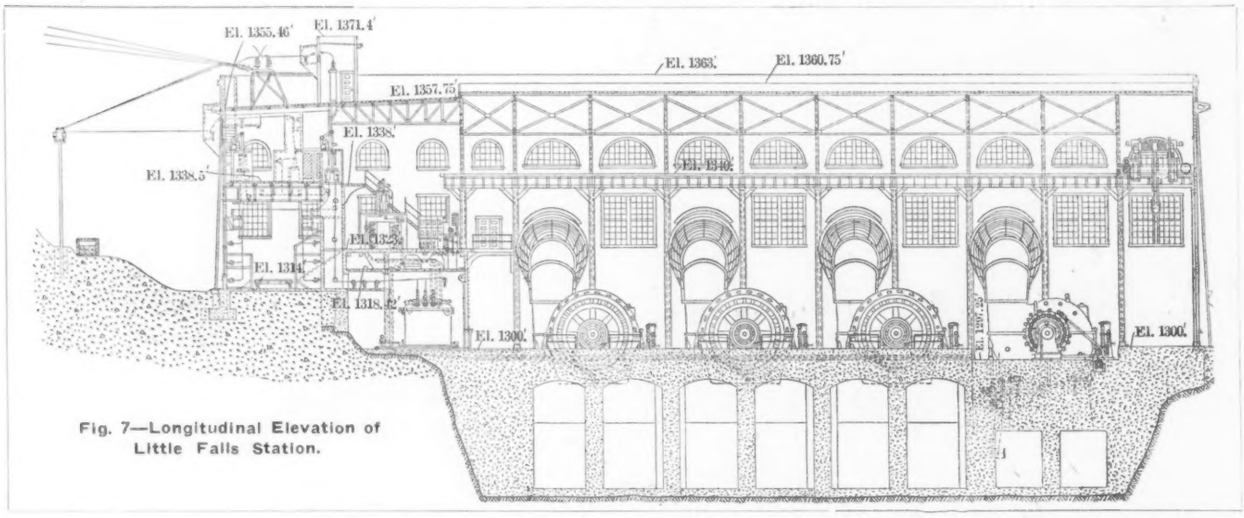


Fig. 7—Longitudinal Elevation of Little Falls Station.

ment for speed to be made by the switchboard operator. The oil pump is of the vertical type, connected by belt to the turbine shaft, and furnishes oil to the governor mechanism at a pressure of 150 lb. The oil systems of the four units are interconnected and all fittings and piping are grounded. The non-inductive load regulation of the generators is 4 per cent.

The exciters, which are rated at 120 kw and 250 volts, are mounted upon the ends of the main generator shafts, thus greatly simplifying the station construction as com-

pared with the usual construction where a separate penstock and waterwheel are provided for running the exciter. This form of construction was successfully used at the company's plant at Post Falls, and the gain in space, the saving of the complications of additional waterwheels of smaller size, and the increased efficiency of the drive, have proved so satisfactory that the plan was not only followed in the Little Falls station but will be in the Long Lake station.

The waterwheels for the Little Falls installation were purchased on a bonus and penalty basis for efficiency performance, and the high results, together with the excellent generator and exciter efficiencies, have made it possible to operate this plant from water to switchboard at a joint station efficiency (at the high-tension line outlets) of 83.5 per cent. This includes all losses in forebay, gates, penstock and tailrace, waterwheels, generator-station wiring, etc., and shows what is now possible to obtain without extravagant expenditure, for the unit costs of this plant are moderate and compare well with those of other plants.

Fig. 8—Switchboard Gallery, Little Falls Station.

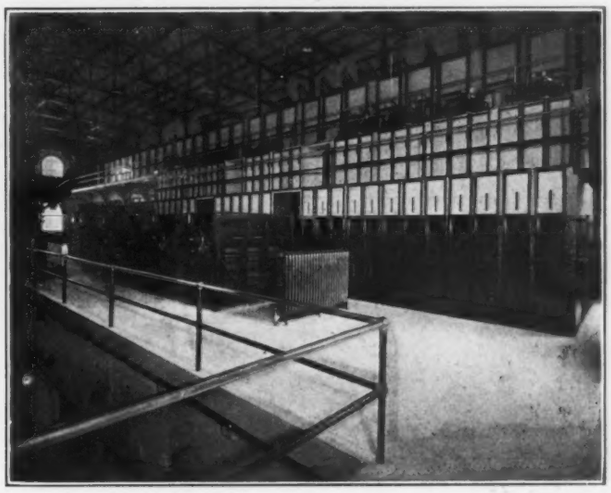


Fig. 10—Low-Tension Bus Compartment and Generator Rheostats.

TRANSFORMERS.

There are four transformers, each installed in a separate fireproof cell on the first floor, and any transformer may be connected to any generator. A fifth cell is constructed for probable future requirements. The base of each transformer is arranged with wheels to facilitate moving it on a track into the generator room far enough to permit it to be handled by the crane. Each transformer is rated at 5000 kw at 90 per cent power-factor and is wound for 4000 volts delta to 63,000 volts star, with neutral grounded. The guarantee for regulation on non-inductive load is 1 per cent and at 90 per cent power factor 3 per cent. The efficiency at full load is 98.4 per cent.

The transformers are oil-immersed and water-cooled, the water being taken from the forebay through a filter. Pipes carry the water from each of the transformer coils through three hoppers balanced on a pivot by counterweights and so arranged as to open the circuit of a pilot lamp in case of a clogged pipe, when the water will not flow fast enough to overflow the hoppers. A thermostat within the transformer opens a contact—in case of too high temperature—which is in series with the above alarm circuit. Normally the pilot lamp within view of the operator is lighted and an auxiliary bell will give an alarm in case there is too little water flowing in the cooling coils or too high a temperature within the transformer.

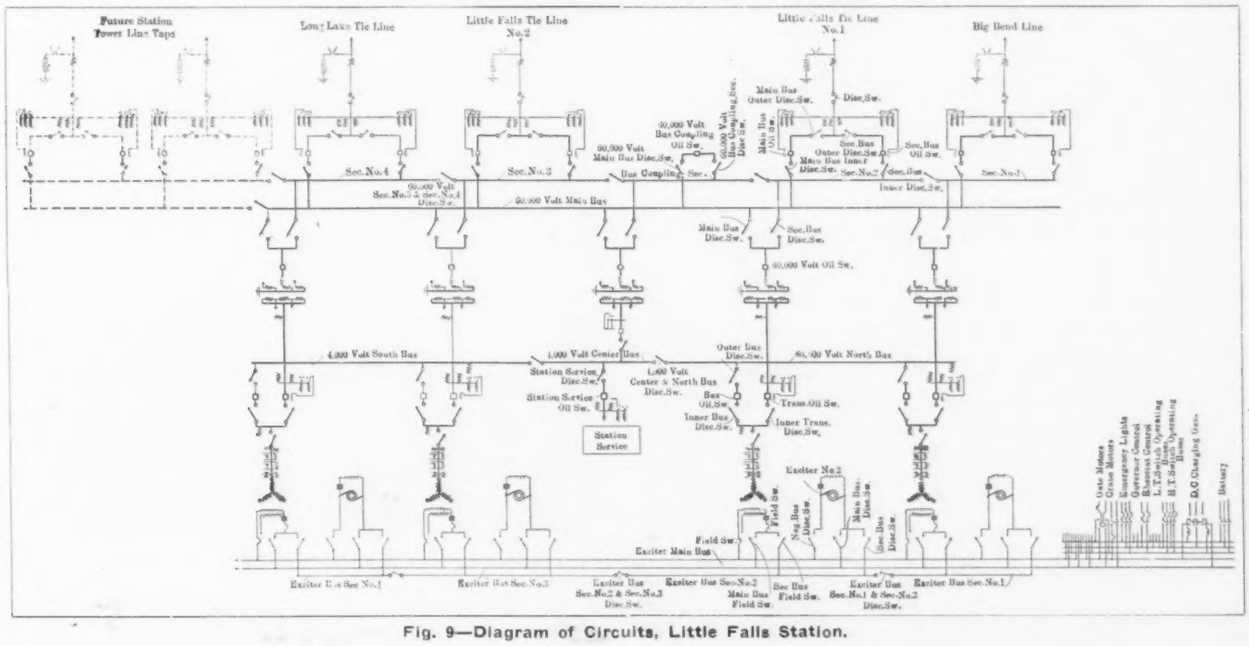


Fig. 9—Diagram of Circuits, Little Falls Station.

SWITCHING APPARATUS.

The 60,000-volt and 4000-volt oil switches are of the motor-operated, remote-control type. All of the control wiring is run in conduit thoroughly grounded, and the operator is not called upon to handle any switches having on them a potential of more than 250 volts. A feature of the layout worthy of comment is the space allowed below the switchboard gallery by means of a hanging floor for

Fig. 11—60,000-Volt Buses and Disconnecting Switches.

these control and instrument wires. All of the wires are in separate iron conduits and in no case are the conduits cemented into floors, so that all of the circuits are easily accessible for changes and repairs.

Another feature worthy of attention is the arrangements of buses and switches within easy reach of the switchboard operator. The switchboards are arranged around the sides of an imaginary 16-ft. square, at the center of which is the operator's station. From this position he is able to read every switchboard instrument and within half a dozen steps to control absolutely any electrical circuit in the station. The telephone connecting by duplicate lines all parts of the company's transmission system is located in an insulated booth 10 ft. from the benchboard. Thus an operator in assuming the duties of his shift may see at a glance the actual condition of the switches without any unnecessary travel. All of the low-tension and half of the high-tension switches are within the range of his vision from the switchboard. Moreover, if any trouble should develop within the control circuits it can be speedily found and rectified. In emergencies the operator can also control from his station in the switchboard gallery the motor-operated headgates, thus shutting down any unit by this method.

One end of the switchboard gallery contains a double 4000-volt bus structure with a passage through its center and over it the oil switches. This structure contains the instrument transformers and the 4000-volt disconnecting switches. The high-tension series transformers are located between the high-tension line oil switches in the line uptake. The high-tension switches are on the upper level to the rear of and above the low-tension switches. For the 60,000-volt bus work seamless copper tubing is used and supported on Ohio Brass Company's four-shell, pin-type insulators. The disconnection switches are of 300-amp capacity and are mounted on post-type insulators. The high-tension buses are housed in a separate bus room, the buses being arranged along either side on 14-in. porcelain insulators and separated 48 in. from each other. The entire control connections are shown diagrammatically in Fig. 9. From an operating viewpoint the control layout has much to commend it. Aluminum lightning arresters are employed on the high-tension lines and are housed in separate compartments on the roof of the station. These compartments are provided with means for receiving sufficient heat from below to keep the electrolyte from freezing in winter.

The station at Little Falls is at once pleasing in design and finish and compact as regards equipment and ease of operation. The floors are of white tile, the walls have a buff color finish, and the machinery, ironwork and wainscot are painted olive green. Everything about the station has a spick and span look, contributing very materially to the self-respect and efficiency of the operating force. Designed by the same engineers to whom was intrusted the work at Post Falls, the station follows along the lines which experience at the latter plant has shown to be conducive to reliability and excellent results.

TIE LINE.

Duplicate three-phase lines carried on steel towers through a 100-ft. right-of-way convey the energy from Little Falls to the main distributing and switching station at Twenty-ninth Avenue, Spokane. The line is composed of aluminum nineteen-wire cable of 270,000-circ. mil area. Insulation is afforded by four units of suspension-type insulators in series, each unit being guaranteed to withstand a wet break-down test of 59,000 volts, or the assembled insulator one of 178,000 volts.

Although the illustration (Fig. 12) shows the tower lines arranged vertically, one circuit on each side of the tower, it has been found expedient to lengthen the middle cross-arm 9 ft. so as to bring the center line out 4.5 ft. beyond the other two on each side of the tower. There is a separation of 7 ft. between cross-arms. The towers are spaced 650 ft. apart and are built of angle iron bolted together in the field. All steel material entering into the construction of the tower is heavily galvanized. The cross-section of the tower is a square throughout its whole length except at

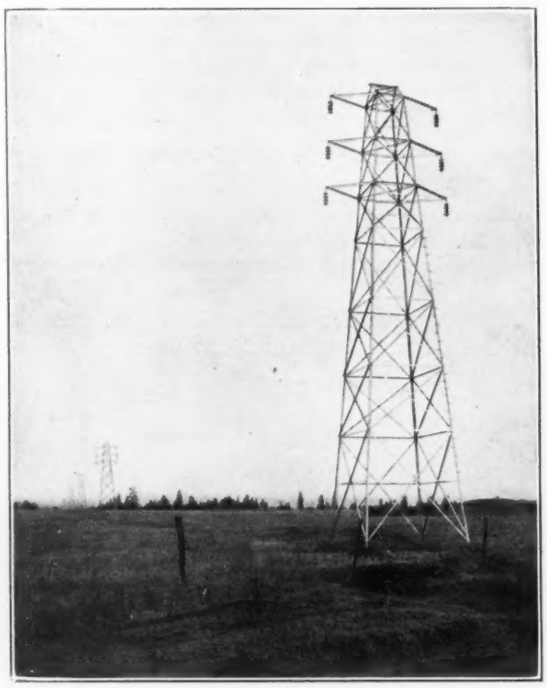


Fig. 12—Steel Towers of Little Falls Transmission Line.

the top, which forms a ridge, on the peak of which are carried two ground wires of ⅜-in. steel cable.

The towers are of a height to bring the lowest wire of the circuit 50 ft. above ground. Patrolmen go over the line twice a week, and at least two grounding hooks are carried, the wires being short-circuited and grounded at points where a patrolman is at work. An arcing rod is also used to avoid the possibility of an arc jumping from the

cable to the tower and thus burning off the cable, aluminum melting at 1200 deg. Fahr. and wrought iron at 2800 deg. Fahr.

LONG LAKE DEVELOPMENT.

When the first unit of the Little Falls plant had been put into operation, and in fact a year before the Little Falls plant was finally completed, it became evident that additional generating capacity would soon be required and work was commenced upon a much larger power development at Long Lake.

At this point the Spokane River passes through a box canyon, the walls of which rise about 400 ft. above the river. By the construction there of a dam, approximately 200 ft. in total height, a fall of 170 ft. will be created and a storage lake 23 miles in length and averaging three-eighths of a mile in width will be formed. Considering only 15 ft. of storage, the water thus held for reserve will amount to 2,695,000,000 cu. ft., all of which will be available not only for the Long Lake plant but also for the one at Little Falls.

The dam to be constructed at this point will be unique in at least two important particulars. Owing to the topography it has not been considered feasible to provide a spillway for flood waters except over the dam itself. This means that the dam will not only be higher than any other spillway dam now in existence, but it will at times of flood carry about 19 ft. of water over its crest. It has been determined to hold the low-water level of the lake at the same level as at high water. This will be accomplished by the use of three roller dams of German type, mounted upon the crest of the spillway. Each roller will be 65 ft. long and 19 ft. deep and will be operated by suitable power mechanism.

At the date of this writing the water of the river has been diverted from the old riverbed by a short tunnel; the excavation for the dam is well advanced, and it is expected that the placing of concrete will commence in the coming summer. The site of the power station is partly excavated and a large cofferdam to enable the completion of the wheel-pits and tailrace is now being pumped out.

The plant will consist of an ultimate installation of four 13,900-kva generators having a continuous overload capacity

Fig. 13—Long Lake Development on Spokane River. Power-House Site Within Cofferdam on Right.

of 25 per cent. Each generator will be connected to an I. P. Morris waterwheel rated at 22,500 hp, the largest waterwheels ever built.

CONSTRUCTION CAMP.

The construction of this plant has required the building of a railroad 22 miles in length from the nearest railroad point, and all material, machinery and supplies, estimated at 100,000 tons, are thus delivered directly upon the work and in the power station. The entire work is covered by three Lidgerwood cableways of 13 tons capacity each, which are used for excavating and delivering materials and machinery to the various parts of the job. A large part of the excavation is done by steam shovels, which deliver their output to ballast cars operated to the dump by steam locomotives. The concreting plant is entirely a gravity

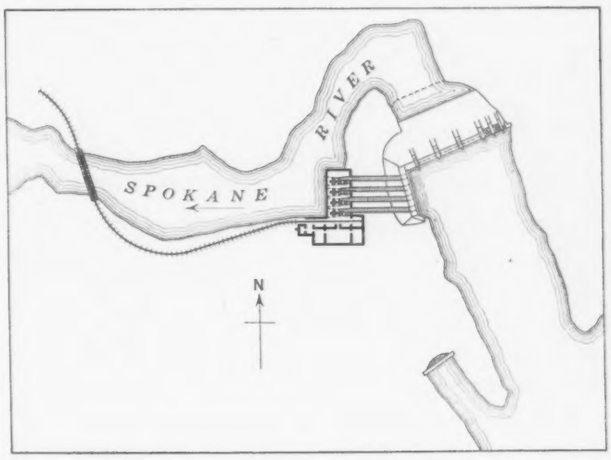


Fig. 14—Long Lake Development of Washington Water Power Co.

system, Haines mixers and a gravity spouting method of delivering the concrete to the forms being used. Large stones will be embedded in the work, thus forming a cyclopean masonry construction, which has been successfully used by the company in its other stations. Energy for construction purposes is obtained from the Little Falls plant, and nearly all operations are conducted by compressed air derived from two motor-driven compressor plants rated at 500 hp each.

The number of men employed in this work is about 500. These men with their families make a village of nearly 800, for whom the company has built quarters provided with suitable sanitation, a pure water supply and electricity for lighting. A large commissary, general store and post office and a mess hall for unmarried men have been provided. No liquors are permitted on the property, and the company has constructed a commodious club building, consisting of reading rooms, baths and gymnasium. A suitable hospital with surgeon and nurse always in attendance has also been provided.

The company carries on all its own engineering and practically all its construction work, maintaining an organization for that purpose. It should be pointed out that every responsible man connected with the Washington Water Power Company from the president down is a trained and experienced engineer. No contracts are let for commissary, mess hall, etc., as it is felt that these parts of its establishment are of too great importance to the well-being and satisfaction of its employees to let out of the company's hands. The company store is maintained for the convenience of the employees, and goods of excellent quality are sold at moderate prices. The men are not required to deal there, however, so that this feature is viewed only as a benefit and thus the irritation which inevitably follows a different policy is avoided.

No attempt will be made at this time to describe this plant in detail, but later on when the work is further advanced and the plans are more crystallized it is expected that many of the really interesting features will be more fully set forth. In a subsequent article the Washington Water Power Company's steam-turbine station in Spokane, the Post Street and Twenty-ninth Avenue substations, the system control and the transmission system will be taken up and their chief features recounted.

OPERATION OF PLUNGER ELECTROMAGNETS.

By Charles R. Underhill.

According to Clerk-Maxwell's law, when there is an electric current through a long coil with an iron core, and when the coil and core are divided at the center and their halves are in perfect magnetic contact, as in Fig. 1, the pull P, in dynes per square centimeter, is

$$P = \frac{B^2}{8\pi}, \qquad (1)$$

wherein B is the magnetic induction in the iron core. The core is assumed to fit the coil snugly.

Now,

$$B = 4\pi I + H, \qquad (2)$$

wherein I is the intensity of magnetization in the iron, and

Fig. 1—Theoretical Electromagnet.

H is the magnetizing force due to the current through the turns in the coil.

Since

$$4\pi I = \frac{\phi i}{S} \qquad (3)$$

and

$$H = \frac{\phi_\alpha}{S}, \qquad (4)$$

wherein ϕi may be considered as the induced flux, ϕ_α the

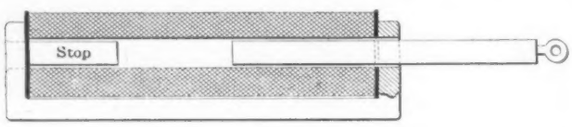


Fig. 2—Test Electromagnet.

inducing flux and S is the cross-sectional area of the core, in square centimeters (2), may be written

$$B = \frac{\phi i + \phi_\alpha}{S}. \qquad (5)$$

Fig. 3—Leakage Paths Near Beginning of Stroke.

Fig. 4—Leakage Paths Near End of Stroke.

Then (1) becomes

$$P = \frac{1}{8\pi}\left(\frac{\phi i + \phi_\alpha}{S}\right)^2. \qquad (6)$$

Expanding (6),

$$P = \frac{\phi i^2}{8\pi S^2} + 2\left(\frac{\phi i \phi_\alpha}{8\pi S^2}\right) + \frac{\phi_\alpha^2}{8\pi S^2}. \qquad (7)$$

The pull is thus resolved into three components. Conventionally stated, $\frac{\phi i^2}{8\pi S^2}$ is the pull between the two iron half-cores, $2\left(\frac{\phi i \phi_\alpha}{8\pi S^2}\right)$ the total pull between the half-coils and the corresponding half-cores, and $\frac{\phi_\alpha^2}{8\pi S^2}$ the pull between the two half-coils.

It will be noted that the middle component of (7) is made up of two pulls, each being equal to $\frac{\phi i \phi_\alpha}{8\pi S^2}$. In the common type of plunger electromagnet, as in Fig. 2, one of the half-cores is immovable and therefore only one of these pulls is available. Furthermore, the coil is not divided and is fixed in position, so that the pull equal to $\frac{\phi_\alpha^2}{8\pi S^2}$ is also unavailable.

Hence, in the common type of plunger electromagnet, when the length of the air-gap is zero, the total pull required to move the plunger away from the stop may be expressed as

$$P = \frac{\phi i^2 + \phi i\ \phi_\alpha}{8\pi S^2}. \qquad (8)$$

$\frac{\phi i^2}{8\pi S^2}$ is the pull between the movable plunger and the fixed stop. $\frac{\phi i \phi_\alpha}{8\pi S^2}$ is the pull between the magnetizing force, due to the ampere-turns in the coil, and the magnetic induction in the plunger.

The latter pull exists regardless of the presence of the fixed core or stop, the return circuit for the flux in the single iron plunger being partly through the air-core of the coil, but mostly through the walls of the coil and the surrounding atmosphere and back to the other end of the plunger. Figs. 3 and 4 show the leakage paths above mentioned. The coil and plunger are the same as in Fig. 2, but without the stop and iron return circuit. The pull in case of both Fig. 3 and Fig. 4 was found to be approximately 3.6 kg (about 8 lb.) with 10,000 ampere-turns in the winding, being slightly greater for the position of the plunger shown in Fig. 4 than for that in Fig. 3.

Tests of the coil and plunger only have shown that for

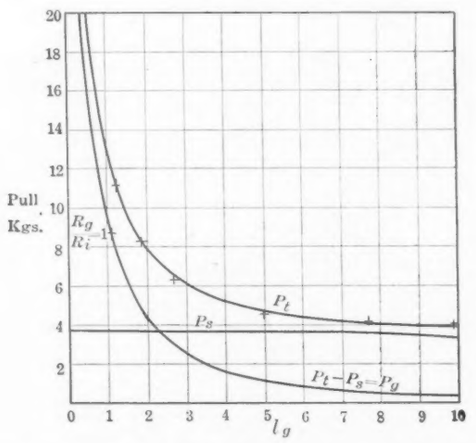


Fig. 5—Pull Characteristics of the Electromagnet Which Is Shown in Fig. 2.

high densities in the plunger the presence of an iron frame does not greatly affect the pull excepting at the beginning of the stroke. The slightly increased pull is attributed to the fact that the plunger becomes saturated sooner owing to the better return circuit, but the fact remains that much of the flux passes through the atmosphere even when a magnetic return circuit is used.

For the purpose of this article, a set of tests described in this paper on May 20, 1905, will here be referred to. The

data were obtained with a coil 30.5 cm long, of 2.76 cm radius, and provided with an insulated No. 24 wall brass tube of such diameter that an iron plunger of 6.45 sq. cm cross-sectional area could move freely within it. Tests were first made with the coil and plunger only; next with a massive iron frame around the coil and finally with stops of various length. The core was, purposely, highly saturated in each case, 10,000 ampere-turns being constantly maintained in the coil. The general proportions used are indicated in Fig. 2.

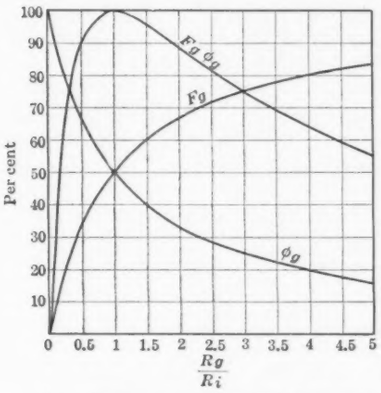


Fig. 6—Force, Theoretical Flux and Energy Curves for Air-Gap.

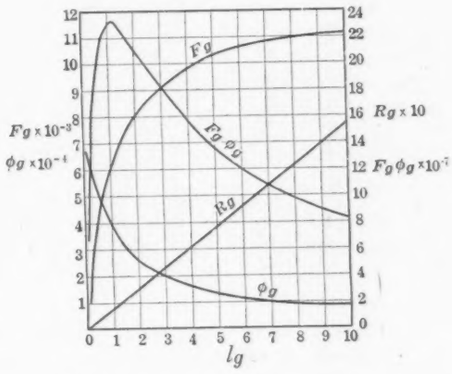


Fig. 7—Calculated Air-Gap Characteristics of Test Electromagnet.

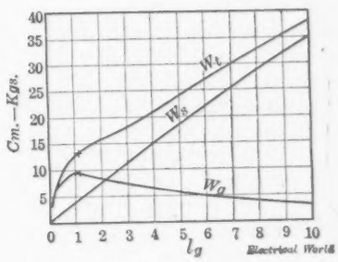


Fig. 8—Work Curves of Test Electromagnet.

The characteristics shown in Fig. 5 are from a test with the iron stop inserted 7.6 cm into the coil. P_s is the pull between the magnetizing force, due to the ampere-turns in the coil, and the magnetic induction in the plunger, and P_t is the total pull. The difference between these two pulls is the pull P_g, which is due to the flux ϕ_g, in the air-gap, between the faces of the plunger and the stop.

The pull P_g can approximate P_t only when the pull P_s has a very low value, as is true in electromagnets with exceedingly short air-gaps and with cores or plungers of great cross-section. Theoretically, this pull must always exist, however small its value be, it being more marked in electromagnets with long air-gaps, for the same total pull, than in electromagnets with short air-gaps. Thus, for a given electromagnet and a constant pull, P_t might approximate P_g for a zero air-gap, while $P_t = P_s$, very nearly, for very long air-gaps.

The points marked on the curve P_t, in Fig. 5, are from the actual test data for the total pull. The rest of the curve was calculated in a manner which will be explained. The curve P_s is from the actual test of the coil and plunger.

In what follows the reluctance R_g of the working air-gap is considered as varying directly with the distance between the plunger and the stop; hence no allowance has been made for fringing. Since magnetic leakage from the plunger to the frame tends to increase the pull P_s, which is definitely known, the leakage factor has been neglected also. It was found by experiment, for this particular solenoid, that the pull varied directly with the ampere-turns for excitations over 6000 ampere-turns, which shows that the plunger was thoroughly saturated at 10,000 ampere-turns. The natural conclusion is that, aside from leakage, the reluctance of the magnetic circuit, external to that of the working air-gap, is constant for the range of air-gaps under discussion.

A trial calculation from the actual test data indicated a nearly-constant reluctance, external to the working air-gap, of 0.17 oersteds. Taking this as a basis, the curve P_t, which agrees closely with the test data, was calculated in the following manner:

$$F_g = \frac{R_g \, F_t}{R_g + R_i}, \qquad (9)$$

wherein F_g is the mmf for the working air-gap, F_t the total mmf (12,570 gilberts) for the entire magnetic circuit, R_g the reluctance of the working air-gap, and R_i the reluctance of the magnetic circuit exclusive of the working air-gap.

Then

$$\phi_g = \frac{F_g}{R_g}, \qquad (10)$$

wherein ϕ_g is the flux in the working air-gap and is equivalent to ϕ_i in equation (3).

The pull due to the flux in the air-gap is

$$P_g = \frac{\phi_g^2}{8 \pi S^2}. \qquad (11)$$

Since

$$R_g = \frac{l_g}{S}, \qquad (12)$$

wherein l_g is the length of the working air-gap, in centimeters, it follows that

$$P_g = \frac{1}{8\pi}\left(\frac{F_g}{l_g}\right)^2, \qquad (13)$$

whence

$$F_g = l_g \sqrt{8\pi (P_t - P_s)}. \qquad (14)$$

It should be noted that all pulls referred to in the text are expressed in dynes per sq. cm, while those in Fig. 5 are in kilograms.

It has been theoretically proved that the maximum amount of work may be obtained from a plunger electromagnet when the reluctance of the working air-gap is equal to that of the rest of the magnetic circuit.* This is similar to the rule for the maximum wattage which may be obtained in an electrical apparatus connected in series with a line: "Make the internal and external resistances equal." The general principle is shown in a simple form in Fig. 6, wherein R_i is assumed to be constant. It will be noted that the product of mmf and flux reaches its maximum when $R_g = R_i$. $F_g \phi_g$ is, in a way, analogous to the emf multiplied by the current strength.

The point marked $\frac{R_g}{R_i} = 1$, on the curve P_g in Fig. 5, is where the reluctance of the air-gap is 0.17 oersteds, which is the same as the calculated reluctance for the rest of the magnetic circuit.

It is to be noted that the calculated values for $F_g \phi_g$ in Fig. 7, which shows the calculated air-gap characteristics, become at a maximum when the air-gap is 1.1 cm long, which is the point where $R_g = R_i$.

The centimeter-kilograms of work, for varying lengths of air-gap, obtained with the test electromagnet, are clearly shown in Fig. 8. W_t is the pull $\times$ distance which was actually obtained with the complete plunger electromagnet, while W_s is the actual work (pull $\times$ distance) obtained with the coil and plunger only; that is, without any iron

*"The Design of Electromagnets for Specific Duty," by E. R. Carichoff, *Electrical World*, Jan. 27 and Feb. 17, 1894.

stop. The curve marked W_g represents the difference between curves W_t and W_s. It is to be observed that the maximum work (pull × distance) in the air-gap only will be obtained with an air-gap 1.1 cm long, or when $R_g = R_t$.

The characteristics shown in Fig. 8 prove conclusively that the "solenoid effect" must always be taken into consideration in the design of plunger electromagnets, and that the air-gap characteristics are only of secondary importance where a long travel of plunger is desired. Designers should bear in mind the fact that the "law of inverse squares" cannot be directly applied to plunger electromagnets, even in the air-gap, since the mmf constantly decreases as the length of the air-gap decreases.

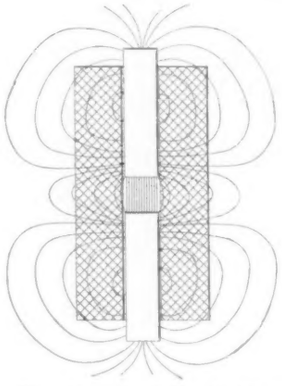


Fig. 9 — Leakage Paths of Plunger Electromagnet with Air Return Circuit.

Fig. 9 shows that the pull P_s in plunger electromagnets can be attributed to joint reluctance. When the air-gap is long the flux leaks back through the walls of the winding and through the frame or atmosphere to the other end of the plunger. A similar effect takes place for the stop. This leakage causes the plungers to be much more strongly saturated than would be the case if all the flux went through the air-gap; hence, there is a strong pull on account of the solenoid effect.

Further conclusions are that for plunger electromagnets of the type discussed the pull is not appreciably affected, excepting for short air-gaps, by the presence of an iron frame. When low flux densities and short air-gaps are employed the dimensions of the iron frame become important. Clerk-Maxwell's law, as usually stated, does not apply to common types of electromagnets.

A plunger electromagnet with two movable plungers, arranged end to end, and linked together so that they will pull together, will exert a greater pull than will one with a fixed stop, since the pull due to the solenoid effect on the stop may also be taken advantage of. Such an electromagnet is now in use on standard apparatus.

The pull due to a solenoid and plunger may be calculated from observed data, and the value of the magnetizing force, at different points along the axis of the coil, may be accurately determined; but a careful study of the reluctance of the leakage paths from the end of the plunger through the walls of the coil and back to the protruding plunger or the iron frame must be made before the design of the plunger electromagnet becomes a matter of exact calculation.

LARGEST SINGLE STORAGE-BATTERY INSTALLATION IN THE WORLD.

The Consolidated Gas, Electric Light & Power Company, of Baltimore, Md., possesses what is held to be the largest single storage-battery installation in the world, the next largest battery in size being owned by the New York Edison Company. As is quite well known, the Consolidated Gas, Electric Light & Power Company has a large steam station at Westport, just on the outskirts of Baltimore. It also is the largest user of the transmitted energy generated by the Pennsylvania Water & Power Company at Holtwood on the Susquehanna River, better known as the McCall's Ferry development. Ordinarily the greater part of the load in Baltimore is carried by the hydroelectric station at Holtwood, Pa., a 40-mile transmission line connecting the terminal station at Highlandtown, Md., with the generating station. In order to safeguard its customers against interrupted supply in case of mishap to the hydroelectric station at Holtwood, to the transmission line, or to the steam station at Westport, it was decided to install this battery.

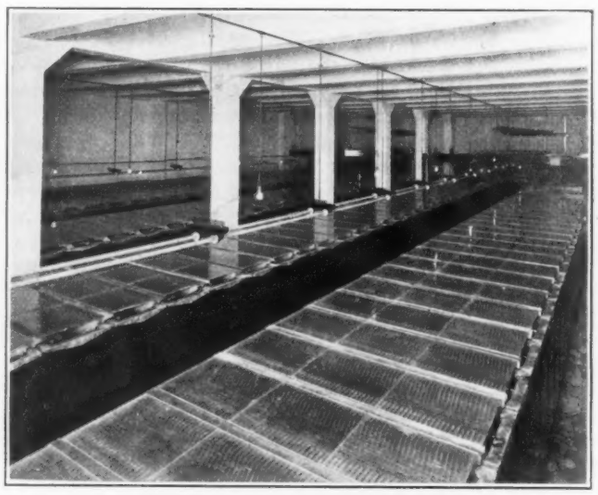
The battery house adjoins the substation of the company on McClellan Street between Baltimore and Fayette Streets, Baltimore. The station was especially designed and constructed for the battery and its equipment, and provision has been made for an additional story to accommodate another battery of similar size if necessary. The specifications for storage-battery stations as enacted by the Association of Edison Illuminating Companies were followed in the design so that the layout accords with standard practice.

The battery comprises 152 cells, each of which contains 133 plates, and was installed by the Electric Storage Battery Company, of Philadelphia. The next largest battery contains 150 cells, each equipped with 131 plates. The cells are arranged in four rows and are covered with heavy glass plates. The total weight of the equipment is 616.5 tons, distributed as shown in the table.

GENERAL DATA ON BALTIMORE STORAGE BATTERY.

Articles.	Weight in Tons.	Articles.	Weight in Tons.
Tanks	72	Porcelain insulators	9
Glass plates	18	Copper buses	16
Electrodes	303	End-cell switches	6
Lead busbars and lugs	13.5	Separators	21
Acid	138	Miscellaneous equipment.	20

The battery is kept connected to the busbars supplying the direct-current service and in the event of any interruption will immediately assume the load without any interruption to the service. It will deliver 44,000 amp at 250 volts for six minutes or 11,000 amp for one hour. The capacity at the six-minute rate is 11,000 kw. The battery will thus be able to carry the entire direct-current load on the system for a period varying from ten minutes to several hours, depending on the magnitude of the load at the time of discharge.



Storage-Battery Installation of the Consolidated Gas, Electric Light & Power Company, Baltimore, Md.

The McClellan Street substation receives energy from the Westport station and from the Highlandtown terminal station at a tension of 13,000 volts, 25 cycles. The tension is stepped down and the energy converted into direct-current energy by rotary converters and distributed underground at a tension of 250-125 volts in the business section.

Central Station
Management, Policies and Commercial Methods

WOOD-MILL MOTOR DRIVE REPAID ITS COST IN NINE MONTHS.

The Commercial Mill & Building Company, of Salt Lake City, Utah, which does a general contracting and mill business, formerly operated its wood shop by steam power. The company's books showed the cost of running the plant to be $1,376 for one year, the last in which the isolated-plant equipment was operated. In February, 1911, a motor-service solicitor from the Utah Light & Railway Company succeeded in interesting the mill owners in a proposal to electrify, pointing out the saving to be effected. Alternating-current motors using 36 hp were installed at a cost of about $750. According to Mr. William Selley, manager of the company, the cost of operating these motors one year, including oil, etc., was only $434.55, showing nearly $1,000 saving over the cost of steam drive and representing a gratifying economy over even the conservative figures quoted by the solicitor. At this rate the motors paid for themselves, regardless of steam-plant salvage, in about nine months.

LADIES' RECEPTION ROOM IN CENTRAL-STATION OFFICE.

A section of the business office of the central-station company at Fort Wayne, Ind., has been divided off and furnished attractively as a ladies' reception room, an invitation being extended to women residents to make free use of the apartment as a meeting place, rest-room, etc. A handsome indirect lighting fixture and a luminous radiator make up the simple electrical equipment of the room, while a writing desk and stationery, armchairs and toilet are among the conveniences offered to women patrons. In tendering the use of the room to the women of Fort Wayne Mr. J. B. Weidgenant, superintendent of sales, has studiously avoided any appearance of forcing a display of electrical appliances on callers. He believes, instead, that by removing all idea of obligation freer use will be made of the apartment, and that this will result in larger ultimate benefit through arousing interest in appliances and thus leading to sales.

AUTOMATIC ALL-NIGHT SERVICE AT EXETER, NEBRASKA.

Exeter, Neb., a town of 1,000 population, has twenty-four-hour electrical service. During daylight hours a 35-hp Hornsby-Ackroyd oil engine furnishes the 110-volt direct-current supply. At dusk a 35-kw Curtis steam-turbine set is started up in addition, and carries the peak load and evening demand until midnight. At this hour the attendant shuts down these units and starts a 10-hp gasoline engine set, leaving this engine to run unattended until morning. The employee lives only two blocks from the plant, and in his home is a no-voltage alarm relay which operates to waken him if the engine should fail or stop. The town fire alarm is given by the power plant whistle. For night alarms this whistle is connected to the telephone circuit so that the exchange operator can control the warning. Mr. C. C. Smith is owner and manager of the Exeter Electric Light & Power Company.

A MECHANICAL COMPUTER FOR ELECTRIC ENERGY RATES.

By W. H. Edmondson.

With the increasing complication in central-station rate schedules for the sale of electrical energy especially for motor service, the solving of even a small number of concrete problems becomes a tedious process and one requiring careful and accurate figuring. In making estimates in the course of a selling argument where the demand and hours of usage may have to be revised several times during an interview it is possible to make embarrassing mistakes.

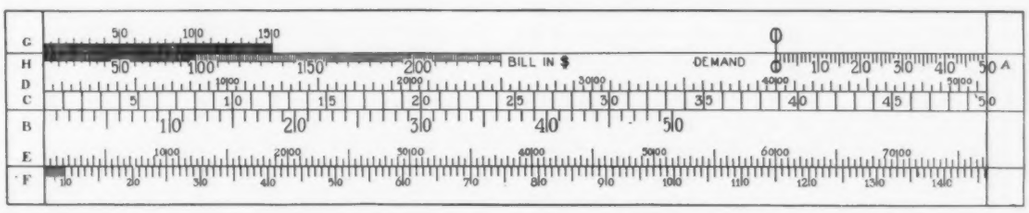


Fig. 1—Slide-Rule for Calculating Central-Station Rates.

In investigating the rates of one of the large central stations the writer worked out a number of curves showing graphically the cost of energy for various uses on which competitive rates were to be based. The labor was minimized by the construction of tables, and later a device in the form of a slide-rule was developed which has since proved a great time-saver and otherwise useful in many ways.

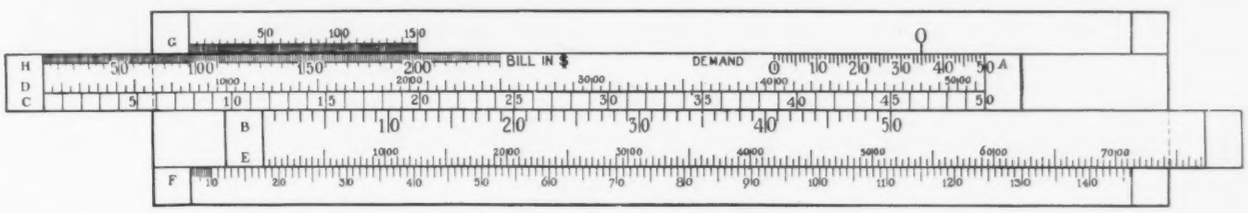


Fig. 2—Slide-Rule Set for Calculation.

As the rates of many central stations are based on the same principle, though differing slightly in detail, scales for such a rule can readily be calculated to suit almost any

case. In the one here described the scales were spaced as accurately as possible by a draftsman. Two rules were made, one 24 in. long printed directly on blueprint paper and one 8 in. long from a photographic negative. It is of course possible to make a similar device in circular form on the lines of the well-known "Cox" computers, and in this way a more open scale may be obtained.

TABLE I.—CALCULATIONS FOR 35-KW DEMAND; 5100 KW-HR. CONSUMPTION.

35		35	5100
23		80	805 (prim. hrs.)
105		2800 (sec. hours)	4295
70		9 (cents)	2800 (sec. hrs.)
805 (primary hours)		$252.00	1495
12 (cents)			6 (cents)
$96.60 (primary charge)			$89.70
10.00			252.00
99.51			$341.70
$206.11			10.00
100.00	$100.00		$331.70
$106.11	74.277		0.30 (p. c.)
0.70 (per cent)	$174.277		$99.51
$74.277			

Following is the rate for which the scales here illustrated were calculated:

A charge of 12 cents per kw-hr. will be made for all electrical energy furnished under this schedule, with the following deductions, and the minimum charge will be $1 per month per meter.

First Deduction.—A price of 9 cents per kw-hr. will be charged for all energy furnished in excess of 23 hours' use and not exceeding 103 hours' use of the demand for each month.

Second Deduction.—A price of 6 cents per kw-hr. will be charged for all energy furnished in excess of 103 hours' use of the demand for each month.

Third Deduction.—Whenever that portion of a customer's bill which is calculated at the 9-cent and 6-cent rate, or both, exceeds $10 per month, a discount of 70 per cent will be allowed on each excess over $10.

Fourth Deduction.—Whenever a customer's bill, after the foregoing deductions have been made, exceeds $100 per month, a discount of 30 per cent will be allowed on all in excess of $100.

TABLE II.—CALCULATIONS FOR 35-KW DEMAND; 4000 KW-HR. CONSUMPTION.

$96.60		4000	$265.70
10.00		805	0.30 (per cent)
79.71		3195	$79.710
$186.31		2800	
100.00	$100.00	395	
$86.31	60.417	6	
70	$160.417	23.70	
$60.4170		252.00	
		$275.70	
		10.00	
		$265.70	

Consider as an example: Demand, 35 kw; consumption, 5100 kw-hr.

Move scale *A* to the left until 35 is under *O*. Move scale *B* until 35 matches 35 on scale *C* (as seen in the illustration).

Under the consumption (5100) on scale *E* read, in this case, 110 on scale *F*. Under 110 on scale *G* read the amount of the monthly bill in dollars (scale *H*).

If the consumption falls to the left of the demand figure as found on scale *B*, scale *D* should be used instead of scale *E* in comparing with scale *F*.

For instance, if the consumption in the example were 3000 kw-hr., then under 3000 on scale *D* find 66.5, which compared with scale *H* gives $143.

No further setting of the rule is necessary for any other consumption so long as the demand remains unchanged; it is simply a matter of reading and comparing scales *E*, *F*, *G* and *H*.

Table I herewith shows the arithmetical work involved in the above example, while Table II is the work involved in finding the bill for one additional consumption.

While the work involved in figuring by this rate is nothing more than simple arithmetic, yet where so many operations are involved it is easy to make a mistake, and for checking alone the rule has many times demonstrated its worth.

Wiring and Illumination

BUILDING A COMPLETE STREET-LIGHTING SYSTEM FOR A CITY OF 30,000 IN NINETY DAYS.

During the interval from May 10 to Aug. 20 of last year, barely 100 days, a complete new street-lighting system of 250 metallic-flame arc lamps was provided for the city of Ogden, Utah, the work accomplished in this time including the ordering of all materials, erection of 60 miles of distributing pole line and lamp-posts, installation of substation transformers and rectifiers, and final operating

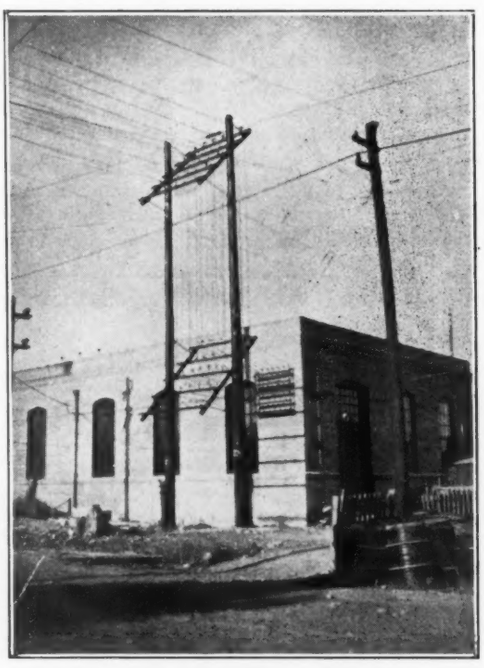


Fig. 1—Substation Entry Construction at Ogden, Utah.

tests of the system. Nearly 250 men worked eight hours a day to accomplish this result, the job being so organized that construction was going on simultaneously in all parts of the city.

On May 1 the newly organized Merchants' Light & Power Company, of Ogden, had awarded to it the city street-lighting contract to furnish 250 4-amp luminous-arc lamps at $4.75 per lamp per month, the contract taking effect Sept. 15. After expressions of considerable skepticism as to whether such a complete new system could be installed within the limited time, the company turned the execution of the job over to the contractor May 10. At once ordering his materials, the latter commenced actual work May 19,

and the system was in operation Aug. 20, almost a month before the limit set.

The Merchants' company obtains energy from the 45,000-volt transmission line which also feeds energy to the Salt Lake and Ogden electric interurban company's Ogden substation. The latter building was added to, practically doubling its size, to house the high-tension transformers and the five Westinghouse 4-amp, 75-lamp rectifier sets. The fifth rectifier outfit is used as a spare for emergency and test purposes. Its terminals are brought up to G. & W. plug contacts in the centers of the squares formed by those of the other four rectifiers, so that in case of breakdown any of the four flexible-jumper lamp-circuit contacts can be transferred to the spare rectifier. The latter can also be connected to the station test circuit in the same way.

A unique entry construction for the outgoing lines from the Ogden substation is shown in the accompanying illustration. The wall outlets were low, any kind of a roof structure was to be avoided, and the wires must clear a number of other circuits already erected, so the simple construction illustrated was adopted. Two 60-ft. poles form the uprights, between which are pinned the diagonal frames made

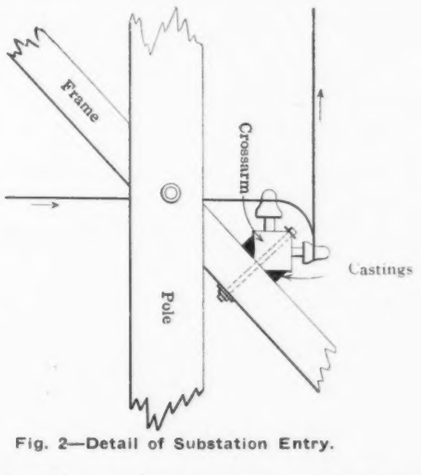


Fig. 2—Detail of Substation Entry.

up of 6-in. by 8-in., 45-deg. members and 4-in. by 4-in. cross-arms carrying the insulator pins. Each wire is carried on both horizontal and vertical pins at each frame, so that its tension is resisted squarely. The cross-arms are seated with their plane faces respectively vertical and horizontal, by means of 45-deg. iron castings which block in the space between the cross-arms and the diagonal members. The connection here is by through bolts, passing through holes drilled squarely through the frames and along the diagonals of the arms. The outside frame pieces are thoroughly braced to the poles, and the whole structure is guyed to offset the unequal tension of the wire spans. Construction was begun on the substation June 15, and it was ready for operation Aug. 1.

Installation of the outside wire plant required the setting of 1780 poles, measuring 40 ft. to 60 ft. in height, and the stringing of 60 miles of line. In laying out this work, the four circuits were so located that they might follow the main trunk lines over which the company plans later to furnish commercial service in Ogden. In this way a large part of the construction for the commercial lines is anticipated, which will work considerable economies in later work. No poles were used less than 40 ft. in length, and the majority are 60-ft. poles with 9-in. to 12-in. tops, as the new Merchants' circuits were required to pass above all existing lines. Six-pin arms are employed exclusively, the arc-circuit wires occupying the outermost pins throughout, leaving the pole pins for commercial use. The series-arc conductor is of weatherproof No. 6 copper.

The line work was organized in four sections, construction proceeding simultaneously on each of the four circuits. Following the engineers who went ahead to locate the lines, came the post-hole gangs, each comprising a foreman and ten groundmen. Next came the pole-setting gang, made up of a foreman, two linemen, two groundmen and a team. Wherever possible the Merchants' lines follow alleys and property lines within the blocks, so that derrick wagons could not be used, and all this work had to be done by hand with pike poles. Cross-arms and steps were next nxed on the poles by a third gang, consisting of a foreman, six linemen, three or four groundmen and a couple of teams. The crew following, composed of about the same number, strung up the conductor, and the next gang placed insulators, pulled up slack and tied the wires. Mast arms were placed and lamps hung and connected by the final crew, finishing the job. On the four circuits the various gangs followed each other by a day or two, and since each crew became expert at its particular work, progress was rapid. The men worked only the regular eight-hour shift, and when construction was going ahead most actively, from June 1 to Aug. 1, nearly 250 were employed. Despite the doubts of many observers, including the company directors themselves, the installation was ready and operating Aug. 20, almost a month ahead of time, and within ninety days of the beginning of actual construction.

Mr. P. M. Perry is general manager of the Merchants' Light & Power Company, of Ogden, and Mr. P. D. Kline superintended the work of constructing the street-lighting system, as the representative of the contractor, the Falkenau Electrical Construction Company of Chicago.

Letters to the Editors

INTERNATIONAL RADIO-TELEGRAPH CONGRESS.

To the Editors of Electrical World:

SIRS:—Your editorial "The International Radio-Telegraph Congress," which appears in the issue of June 8, seems to emphasize the need of continuing the wave-length restrictions suggested by the 1906 Berlin Convention and to give as a reason therefor that "much progress has been made in syntonic work within the past few years." From the viewpoint of an engineer in the field of radio-transmission, the premise and the conclusion appear contradictory.

The Berlin convention stated that merchant ships should communicate with wave-lengths of 300 m or 600 m and that all wave-lengths between 600 m and 1600 m should be reserved for government use. This was in substantial accordance with the practice of commercial wireless companies at that time, since it has been usual to set each ship transmitter at some definite wave-length near 600 m (or, in the case of a smaller vessel, near 300 m) and to do all that ship's telegraphing with that wave-length. The obvious result of placing all transmitters upon one wave-length, with only slight variation, is confusion. This is not only a conclusion which might have been foreseen, but is really a result, as is witnessed by the continual cry of "interference" now heard. The difficulty of communication is certain to continue so long as the present feeble traffic methods are in force and until apparatus of reasonably good design is put into universal commercial service.

It is by no means difficult to arrange transmitters so that their wave-lengths may be varied almost instantaneously throughout a wide range. When this is done, and is taken in combination with present-day flexibility of tuning of receiving circuits, the means for non-interfering wireless communication will be at hand. It will then be possible to give vessels at sea their necessary protection and still to transact telegraph business without jeopardizing the lives of passengers and crews.

All the fundamental needs of radio-signaling could be met should the London Congress take the following steps: (1) Insist upon absolute precedence of distress signals; (2)

require "sharply tuned" (low decrement) signals from all stations, be they on ship or on shore, government, commercial or experimental; (3) provide for a continuous watch of operators at all stations; (4) recall the earlier wave-length restrictions and determine (a) a single "calling" wave-length and (b) a series of official wave-lengths below and above the "calling" frequency.

Under the above-suggested regulation multiple simultaneous communication could be effected with minimum interference. All stations when not actually engaged in the transfer of messages would keep both sending and receiving apparatus adjusted to the common "calling" wave-length and so would at all times be prepared to send or to receive distress or other calls. As soon as communication was established by use of this general wave-length between any two stations desiring to exchange messages both would immediately change to some other frequency (selecting that one which gave least interference under the particular conditions present at that time) and then send their telegrams. This would leave the "calling" tune free from interference and open to the use of other stations in the same locality.

In the interest of rapid service both sending and receiving apparatus should be designed so that the wave-length of either might be changed to any of the officially determined values by a single motion, say by turning an indicator to a certain position for each, without further adjustment or tests. Instruments of this sort have been built and demonstrated, so that the general communication plan need not suffer from difficulty of application. The arrangement outlined has been very carefully considered by a number of men familiar with radio-signaling as it is now carried on, including several of this country's most important delegates to the London congress. It is greatly to be hoped that, in addition to adopting the necessary (but not the superfluous) provisions for message interchange and accounting, the congress will substitute some form of helpful regulation for the obsolete wave-length and power limitations recommended six years ago.

New York, N. Y. John L. Hogan, Jr.

AN OLDFIELD PATENT BILL PROTEST.

To the Editors of Electrical World:

Sirs:—The recent Oldfield patent bill is an attempt to meet the chaotic conditions pervading our patent system, but if passed it will be an utter failure, since it does not meet the demands of the nation-wide request for improved conditions While the bill has some merit, it goes wide of the mark, as it treats symptoms and not causes. The fundamental trouble is not one of law but of government, hence legislation cannot correct our difficulties unless the government of patents is thereby improved. The Constitution of the United States has given this country a government controlled by legislative, administrative and judicial departments. All three jointly are necessary to produce sound government. Anything not so controlled is not governed in accordance with the Constitution.

The writer holds that our troubles have arisen from the fact that patents are controlled only by the legislative and judicial departments, but that the administrative branch is entirely missing. In other words, while for pending applications there exists the triple government, the executive department disappears the moment the completed instrument is handed to the applicant. In case economic difficulties arise such as now exist in some industries there is no specific department to which the matter can be referred. The present patent and property controlled by it are therefore not administered, it is believed, in accordance with the spirit of the Constitution. The first step required in any effectual bill should be to give to this country the constitutional patent.

To overcome the prevailing defect a resolution to President Taft was unanimously adopted in March, 1911, by the St. Louis Section of the American Institute of Electrical Engineers, and subsequently by a number of state and national societies, which reads as follows:

"Whereas the United States patent laws, despite many revisions, continue to cause great suffering, injustice and loss to inventors, owners of patents and their stockholders all over the Union, and

"Whereas it is desired to increase the security and value of industrial property by introducing a system of supervision in patent, copyright and trademark laws,

"Be it resolved, That we, the [here the name of the body passing the resolution is inserted], in regular meeting assembled, respectfully request your honor, and you are hereby so requested, to call the attention of Congress in your next and subsequent message or messages to these conditions and to use your good offices in urging the establishment of a permanent commission or department of supervision of patents and similar properties, and repeat the request until the desired end is obtained; and

"Resolved further, That you urge upon Congress to invest such department with the necessary power, vote a sufficient appropriation for a period of years and authorize the President to appoint the commissioner or commissioners and to establish the department or commission as soon as possible on a working basis."

It stands to reason that no amount of patent legislation will give us the equivalent of correct government, for neither the judiciary nor the legislature is fitted to perform executive duties. If Congressman Oldfield wishes to endear himself to the nation, he should sacrifice his bill and support this resolution, or at least President Taft's recommendation for a commission.

There is at least one point on which all can agree, one common ground on which all can meet, namely, sound government. It must be evident to all that unless the fundamental structure of the administration of patents is sound proposed changes have little value, and therefore all details might as well be dropped until our patent system is brought within the government of the Constitution. If properly organized, the missing department in conjunction with Congress can produce effective laws without causing any disturbance or conflicting with the system in general. These laws should, however, evolve with the administrative department.

Our patent system does not need revolutionary changes; it is not half so bad as many may think provided it is correctly governed, but without any administrative department what can one expect? The creation of this department or commission with the necessary power to produce order systematically is an action which is equitable and for the best interest of all and should be favored and supported. A further study will readily show that such department, if not correctly placed in the government, may either be too powerful or be paralyzed by other conditions surrounding it, so that the mere creation of an executive department for patents does not mean that all our troubles will disappear. It should plan and follow a fixed and stable policy, which cannot well be done by a congressional committee on patents, because the latter labors under the great disadvantage that its personnel changes almost with every new Congress.

If engineers, engineering societies and manufacturers, as well as the journals representing industries, hold the same opinions as the writer, they should express their views in no uncertain terms to the Chief Executive, as well as to Congress in general and to the committee on patents in particular, demanding first and foremost that patents be subjected to all three governmental departments; in short, requesting a constitutional patent and correct administration.

St. Louis, Mo. L. G.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Rectifier.—R. ROUGE.—The author has formerly described the construction of a permutator (permutatrice) for the transformation of alternating current into direct current. He describes now a somewhat different type of machine which he calls a rectifier (rectificatrice) for polyphase currents. His former permutator consisted of a stationary direct-current armature, subjected to the effect of a rotating magnetic field produced by a stationary primary and movable brushes revolving in synchronism and collecting the current from the commutator of the stationary armature. Its advantages over ordinary converters was a smaller weight per unit of power. However, the revolving brushes caused considerable difficulties which are described by the author. He has, therefore, adopted in his new rectifier stationary brushes and a revolving armature. The design of his new rectifier is described in some detail.—*La Revue Elec.*, May 24, 1912.

Flame Arc Lamps.—An account of the conclusion of the long extended discussion of the paper by Hechler, recently abstracted in the *Digest*, on the economy of the modern flame arc lamp and possibilities of its improvement. Bloch stated that drawn tungsten lamps for 200 to 1000 cp consuming 0.8 watt per cp have already proved very satisfactory in practice. But on the whole the situation of the arc lamp for street lighting is by no means so unfavorable as it is sometimes assumed. The specific consumption of flame arc lamps of from 0.2 to 0.3 watt per cp is so far below that of metallic-filament lamps (which is in the best case 0.8 watt per cp) that the total cost of lighting is less in the former case even if maintenance and renewals are taken into account. This is especially true for flame arc lamps the cones of which have a life of from 60 to 100 hours. Norden said that high-candle-power metallic-filament lamps have not yet replaced flame arc lamps and cannot replace them because the public would not welcome the reduction in the light. A general discussion of the present situation of electric lighting systems will take place at a later meeting of the Berlin Electrical Society.—*Elek. Zeit.*, May 23, 1912.

Distortions in Spectral Luminosity Curves Produced by Variations in the Character of the Comparison Standard and in the Surroundings of the Photometric Field.—H. E. IVES.—An abstract of an American Physical Society paper. The ordinary procedure in obtaining spectral luminosity curves by either the equality-of-brightness or the flicker photometer is to compare the spectral colors with a constant standard of arbitrarily chosen color. Former experiments having led to the suspicion that one's estimation of relative brightness of a set of colors such as the spectrum is altered by a change in the color or character of the comparison standard, a series of experiments have been carried out to clear up this point. For the incandescent-lamp light used in the earlier experiments of this series were substituted a red light and a green light, chosen so as to give the same intensity of illumination as the "white light." A large number of luminosity curves were then obtained by both the equality-of-brightness and the flicker method for a high and a low illumination and for large and small photometric fields, using the three colors of the comparison field. These showed that by the equality-of-brightness method the luminosity curves are subject to large shifts and distortions, depending upon the color of the comparison field. These shifts in repetitions of the experiment are not consistent either in direction or in amount, appearing therefore to consist in disturbance of the observer's judgment, or criterion of equal brightness. On the other hand, using the flicker photometer and making the same changes in the color of the comparison standard, no variations were found in the luminosity curves larger than the errors of measurement. Following these experiments similar ones were performed with a bright field surrounding the photometer field, in place of the space usual in optical instruments. Illuminations, field size and color of comparison source were varied as before. Disturbing factors were again found to exist with the equality-of-brightness method, but not with the flicker photometer. The conclusion drawn from this work is that the flicker photometer, under the conditions named, eliminates all disturbing subjective factors and indicates the true brightness of different colors.—*Phys. Review*, May, 1912.

Single-Phase Railway.—An illustrated description of the single-phase railway in commercial operation on the main line from Dessau to Bitterfeld in Germany.—London *Elec. Review*, May 24, 1912.

Automobile Charging.—T. H. SCHOEPF.—An illustrated article on battery charge equipments for electrical automobiles with a drawing giving suitable wiring arrangements.—*Elec. Journal*, June, 1912.

Installations, Systems and Appliances.

Thermal Storage.—A note on a recent British patent (No. 9794, of May 16, 1912) of C. O. Bastian. The storage reservoir is formed of a large number of thin metal sheets bolted together at the corners and kept the requisite distance apart by steatite washers. The heating element is located in the middle of this laminated cube. The whole is inserted in a heat-insulating box, for example, one with double polished walls. An air inlet and outlet in opposite sides of the box are provided. To use the apparatus, both of these are closed and energy is supplied until a predetermined high temperature (400 deg. is suggested) is reached, when the supply may be automatically interrupted. On opening the valves the air enters cold and emerges hot, and may be caused to circulate in pipes in rooms for warming or in ovens for cooking.—London *Elec. Eng'ing*, May 23, 1912.

Wires, Wiring and Conduits.

German Standardization Rules for Insulated Conductors.—A set of new standardization rules of the German Association of Electrical Engineers (representing a complete revision of the old rules) for insulated conductors. Three groups are distinguished—first, rubber-insulated conductors which need not be tested in water; second, rubber-insulated conductors which are to be tested in water, and third, lead cables. Rules are given on construction and tests for these different groups, which are followed by tables giving the permissible current as a function of the cross-section for rubber-insulated copper conductors, for lead cables and for insulated aluminum conductors.—*Elek. Zeit.*, May 23, 1912.

Resistivity and Temperature Coefficient of Japanese Commercial Copper.—T. HIROBE AND H. MATSUMOTO.—An account of resistivity tests of commercial copper wires made by two Japanese wire factories. For hard-drawn copper wire the resistivity in microhms per centimeter cube was found to be $1.58619\ (1 + 0.00419237\ t + 0.0000000164\ t)$ where t is the temperature. For soft-drawn copper wires the resistivity is $1.56400\ (1 + 0.00421788\ t + 0.000002908\ t^2)$. Taking the conductivity of Matthiessen's standard at zero temperature as 100 per cent, that of the samples at the same temperature is 102.78 per cent in the case of hard-drawn wire and 102.18 per cent in the case of soft-drawn wire.—*Report* No. 4; *Third Section of Electro-Technical Laboratory, Ministry of Communications, Tokyo, Japan.*

Electrophysics and Magnetism.

Electron Theory.—O. W. Richardson.—A long abstract of a highly mathematical American Physical Society paper giving some extensions of the electron theory of conductors. In the first part he investigates some consequences of the hypothesis that the collisions of the electrons inside a conductor occur with centers of force which attract them with a force varying inversely as the cube of the mutual distance. Those electrons which contribute to the integrals which determine the thermoelectric properties can be divided into two groups, according as their orbits are closed or open. The additional hypothesis is introduced that the electrons the orbits of which are closed do not contribute anything to the current of conduction. They may, of course, contribute to the polarization current. These assumptions lead the author to formulas which appear to represent correctly in a qualitative manner the variation of resistivity of poor conductors with temperature. The change of metallic resistance due to a magnetic field might be attributed very largely to the effect of the magnetic field in altering the proportion of open to closed orbits and would, therefore, not necessarily exhibit any close correlation with the magnitude or sign of the Hall effect. The second part of the paper deals with the theory of the photoelectric effect.—*Phys. Review*, May, 1912.

Fundamental Electronic Charge.—R. A. Millikan.—An abstract of an American Physical Society paper. The author has formerly shown that Stokes' law of fall is insufficient to account for the motions of small drops through air and has proposed a corrected law. By observing the motions of oil drops in gravitational and electrical fields, this law has now been tested for pressures between 5 mm and 760 mm and found to hold accurately so long as the radius of the drop is more than twice the mean free path of the gas molecule. Thereby the constants in this law have been determined with greater accuracy than heretofore. This, coupled with a redetermination of all of the factors involved in the calculation of the fundamental electronic charge e, has made it possible to obtain a value of this constant the probable error of which is about 0.1 per cent. The new value of e is 4.810×10^{-10}.—*Phys. Review*, May, 1912.

Distribution of Active Deposit of Radium in an Electric Field.—E. M. Wellisch and H. L. Bronson.—An account of an experimental investigation in which the distribution in an electric field of the activity resulting from a long exposure to the emanation of radium was determined for various conditions of pressure, potential, etc. There appear to be no negatively charged carriers, all the so-called anode activity being due to the diffusion of uncharged carriers. The effect on the distribution obtained by causing Röntgen rays to pass through the gas during the exposure was investigated. This effect was appreciable only when the activity and ionization were far from saturation. The difficulty of obtaining saturation both for the cathode activity and for the ray ionization currents is explained as being due to the formation by the particles of neutrons, some of which are subsequently resolved into ions, probably by collision with ions already established in the columns.—*Phil. Mag.*, May, 1912.

Variation of Resistivity with Temperature.—A. A. Somerville.—An abstract of a paper read before the American Physical Society on the change of electric resistivity of various oxides in powder form when the temperature is varied from room temperature to 1100 deg. C. The oxides of zinc, iron, copper, magnesium, manganese and aluminum were tested. All are insulators under ordinary conditions, but the resistance decreases as temperature increases until most of them at 1100 deg. C. are fairly good electrical conductors. The general form of the temperature-resistance curves is the same, being something like that of a parabola, but the actual value of the resistance of various materials at the same temperature differs widely.—*Phys. Review*, May, 1912.

Units, Measurements and Instruments.

Permeameter.—J. Reyval.—In an article on instruments shown at the recent exhibition of the French Physical Society a permeameter of Illiovici is described. As shown in Fig. 1, E is the sample under test, C is a yoke of soft iron sheets, closing the magnetic circuit, while the yoke C' is connected with a ballistic galvanometer Ba or a flux meter

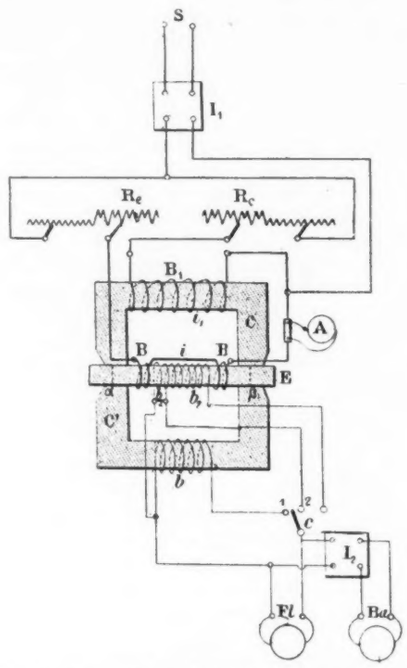


Fig. 1—Connections of Illiovici's Permeameter.

Fl, to use the instrument as a zero instrument. On the sample E is wound a coil B, in which the current is regulated by a double rheostat R_e with continuous regulation, and a coil of fine wire, consisting of two parts, b_1 with twenty-five turns and b_2 with seventy-five turns. On the yoke C a coil B_1 is provided in which the current is regulated by a double rheostat R_e. On the yoke C' a coil of fine wire b is wound. The ammeter A measures the current in the coil B and gives an indication of the magnetic flux in the sample. The ballistic galvanometer Ba or the fluxmeter Fl (one or the other may be used) can be connected either to b or b_1 or $b_1 + b_2$ by means of the switch c. The commutating switch I reverses the current in the coils B and B_1 simultaneously. The commutating switch I_2 reverses the connections of the ballistic galvanometer when this is employed. The coils B and B_1 are so connected that their magnetomotive forces are added together. The use of the apparatus is as follows: A current is passed through B and the current I_1 which passes through B_1 is so regulated that the fluxmeter (or ballistic galvanometer) when connected to b gives zero deflection when the direction of the two currents is reversed by means of switch I_1. Under these conditions the points α and β (the centers of the contact between C' and the sample E) are on the same magnetic potential and the conditions are the same as though the part of the sample E between α and β formed a closed magnetic circuit without joints, and the magnetizing force of the sample is $H = 1.256\, n\, i/l$, where n is the number of turns of B and l is the length $\alpha\beta$. The flux in the sample (hence the induction B) is measured by means of the flux meter (or ballistic galvanometer) connected to coil b_1 or coils $b_1 + b_2$ according to the sensitiveness of the measuring instrument. The Iliovici permeameter, therefore, requires only a regulation to zero and a flux measurement. The joints are eliminated.—*La Lumière Elec.*, May 11, 1912.

Magnetic Tests of Sheet Steel.—VAN LONKHUYZEN.—An illustrated article on new arrangements of Siemens & Halske for magnetic tests of sheet steel according to the standardization rules of the German Association of Electrical Engineers. The method of Siemens & Halske for determining the magnetization curve of sheet steel by a differential or zero method has been so enlarged that it is suitable

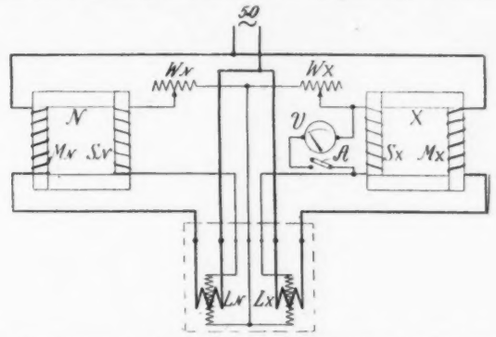


Fig. 2—Arrangement of Siemens & Halske for Magnetic Tests of Sheet Steel.

for determining the loss coefficient (verlustziffer) by a zero method. The arrangement is shown in Fig. 2. *N* is a standard bundle of sheet steel for which the absolute loss coefficient is known for maximum inductions of 10,000 and 15,000. *X* is a bundle of the sheet steel to be tested. It is made of the same cross-section and the same weight as *N*, and primary windings *Mn* and *Mx* and secondary windings *Sn* and *Sx* of equal dimensions are provided for both bundles. The primary winding of each bundle is in series with the main-current coils of two wattmeters, *Ln* and *Lx*, of identical dimensions. The secondary windings of the two bundles are in series with two non-inductive adjustable resistances, *Wn* and *Wx*, and with the voltage circuits of the two wattmeters. The two wattmeters measure powers which are proportional to the loss coefficients *Vn* and *Vx* of the two bundles of sheet steel and are inversely proportional to the resistance *Wn* and *Wx*. If the watt losses in the two iron bundles are equal and if the two resistances *Wn* and *Wx* are equal, the two wattmeters *Ln* and *Lx* give equal deflections. The two wattmeters may be combined into a single differential instrument so that in the case just considered the needle is at the zero point. If the watt losses in the two iron bundles are no longer equal, the differential wattmeter gives a deflection, but this can be reduced to zero by adjusting one or both of the non-inductive resistances *Wn* and *Wx*. In this case the ratio of the loss coefficients in the two iron bundles $Vn \div Vx$ equals the ratio of the resistance $Wn \div Wx$. This equality exists for zero deflection of the differential wattmeter. If now the value of the resistance *Wn* is made equal numerically to the loss coefficient *Vn* of the standard bundle of sheet iron, then for zero deflection of the differential wattmeter the resistance *Wx* gives directly the loss coefficient *Vx* to be determined. All to be done is, therefore, the adjustment of the resistance *Wx* so as to reduce the deflection of the wattmeter to zero. The method can be used therefore by unskilled laborers and is simple, quick and exact. It is pointed out that all sources of error are compensated within wide limits.—*Elek. Zeit.*, May 23, 1912.

Hot-Wire Ammeter for High-Frequency Currents.—J. REYVAL.—At the recent exhibition of the French Physical Society the hot-wire ammeter for high-frequency currents shown in Fig. 3 was exhibited. Tubes *T* of very small diameter and very small thickness and made of a metal of high resistivity and small temperature-resistance coefficient are arranged symmetrically around and soldered to the circumference of two parallel disks *A* and *B* made of a metal of high electric conductivity. Each tube contains one (hot) junction *C* of a thermoelectric couple, from which it is electrically insulated, while the other (cold) junction *F* is placed outside and inclosed by a cap *D* of a metal of high thermal conductivity so that all the cold junctions *F* are maintained practically at the temperature of the caps, which does not change appreciably. All the couples are connected in series. The hot junctions *C* quickly assume the temperature of the tubes, which are heated by the passage of the current to be measured through them. The current enters

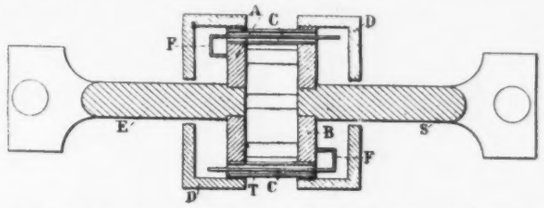


Fig. 3—Hot-Wire Ammeter for High-Frequency Currents.

the disk *A* from *E* and leaves the disk *B* through *S*. When the two free extremities of the series of thermocouples are connected to a galvanometer there is obtained deflection proportional to the square of the current in the tubes.—*La Lumière Elec.*, May 11, 1912.

Miscellaneous.

Alternating-Current Development in America.—WILLIAM STANLEY.—An illustrated Franklin Institute paper giving a sketch of the conditions of the electric lighting industry and its engineering status in the eighties in the United States and the causes which made the alternating-current system necessary in order to remove the difficulties of distribution which had temporarily brought the art to a standstill. An outline is given of the growth of the alternating-current system.—*Journal of the Franklin Inst.*, June, 1912.

Book Reviews

LABORATORY EXERCISES IN PHYSICAL CHEMISTRY. By J. N. Pring. New York: Longmans, Green & Company. 162 pages, 27 illus. Price, $1.25.

A useful little textbook of laboratory experiments in physical chemistry, intended for the use of students in technical college work. The treatment of the subject is descriptive, the technique of the experiments being described in detail; but the theory of the actions is only touched upon. The book is divided into three parts, dealing respectively with physico-chemical measurements, electrolytic preparations, and pyrometry. The first part is further subdivided into calorimetry and electrochemistry. The various experiments and tests are very clearly described. The illustrations in some cases are inferior to the text, being rather sketchy. The chapters on electrolylitic experiments are particularly good. The book will be useful to students of physical chemistry either in or out of college.

CALCUL ET CONSTRUCTION DES ALTERNATEURS MONO- ET POLYPHASES. By Henri Birven. Paris: Gauthier-Villars. 175 pages, 126 illus. Price, 6 francs.

This is a textbook on the design and construction of alternators translated from German into French by M. P. Dufour. It is divided into six chapters, which relate to the following subjects: General considerations, alternator excitation, parallel operation, power and losses of alternators, structural elements, design. The treatment is essentially that of the designer and employs only elementary mathematics. The description is clear and practical. Diagrams and curve-sheets are largely employed. The subjects of armature winding and design receive specially careful development. The volume will be of especial interest to students of electrical machine design and to alternator designers.

New Apparatus and Appliances

EXHIBITS AT THE N. E. L. A. CONVENTION AT SEATTLE, WASH.

The number of exhibitors at the convention of the National Electric Light Association in the Armory at Seattle, Wash., June 10-13, was very flattering to the exhibition committee, considering the distance manufacturers had to send their wares for display. On all sides the heartiest commendation was accorded the committee for its work and for the magnificent setting given to the various exhibits, an impression of which may be gained from the accompanying illustrations. Indeed, the people of Seattle were elated with the display, which was thrown open to the public on the night of June 13 after the convention had adjourned. A brief account of the exhibits follows in alphabetical order.

American District Steam Company, North Tonawanda, N. Y., displayed a number of brass models of special fittings for underground distributing mains for steam heating. Mr. E. L. Barnes was in charge of the booth.

Benjamin Electric Manufacturing Company, Chicago, Ill., had two display boards showing the various forms of electric specialties manufactured by it. These included wireless clusters, plug clusters, pendent fixtures, ceiling fixtures, tungsten arcs, wireless fixtures, tungsten adapters, etc. The fixtures themselves were fastened to a pipe framework, where they were displayed to advantage. Mr. W. D. Steele was in attendance.

Century Electric Company, St. Louis, Mo., had in operation a number of single-phase motors of the regular belted and back-geared type. As is well known, these motors are the self-starting type and do not employ any external starting device other than the knife switch used to close the circuit. A disassembled motor was on exhibition, by means of which the various parts could be subjected to close inspection. Fan motors and small portable motors were also on view. Those in attendance included Messrs. R. J. Russell, H. H. Thedinga, S. B. Smith and R. J. Davis.

Copeman Electric Stove Company, Flint, Mich., showed four of its automatic cook stoves. These stoves are made in three sizes to serve the wants of from two to twenty people, being distinguished by one, two and three compartments. The tops and doors are made of finished asbestos with nickel trimmings, and the cooking compartments are made of aluminum. The energy is applied by means of switches which are in turn operated by a double-pole knife switch controlled by a specially equipped alarm clock, which may be set for starting and stopping the flow of energy. The temperature of the cooking compartment is controlled by a thermometer possessing two hands, one of which is moved to the degree of heat desired and the other of which is actuated by the heat in the compartment. When the two form a contact the supply of energy is interrupted. The heating elements, of which there is one in each compartment, can be removed and attached to the top of the stove for ordinary cooking purposes or, if desired, extra elements can be procured for this service, operated by separate switches. The ovens are well lagged, conserving the heat, and after the circuit has been opened the stove operates on the fireless-cooker principle. Messrs. L. G. Copeman and K. W. Dawson explained the operation of the stoves.

Dalton Adding Machine Company, Poplar Bluff, Mo., had four of its adding machines on exhibition. These machines are electrically operated and add, multiply, subtract and divide, in addition to tabulating. These machines have a particular application in checking payrolls, invoices, discounts, etc. Messrs. V. O. Boone, J. G. Meeko and E. W. Harris represented the company.

Dearborn Drug & Chemical Works, Chicago, Ill., distributed in their booth literature on boiler-feed water, lubricating oils and greases. Messrs. E. C. Brown, J. W. Harkins and J. B. Lincoln represented the company.

Electrical Review and Western Electrician, Chicago, Ill., was represented by Messrs. A. A. Gray and F. R. Schaick. Copies of its convention number were distributed on the trains and at the hotels as well as in the booth in the convention hall.

Electrical World, New York, N. Y., occupied three booths fronting the entrance to the main meeting-room. The convention number of the *Electrical World*, as well as copies of the Convention Daily, were distributed, together with copies of the other publications of the McGraw Publishing Company. The booth was utilized chiefly for reception purposes. Representing the publication were Messrs. H. M. Wilson, A. E. Clifford, C. L. Williams, G. W. Elliott, H. T. Matthew, W. E. Keily, F. F. Fowle, O. H. Caldwell, H. S. Knowlton and W. H. Onken, Jr.

Electric Storage Battery Company, Philadelphia, Pa., featured as a part of its exhibition one of its 133-H-"Exide" emergency cells of the type installed for the Consolidated Gas, Electric Light & Power Company, of Baltimore, Md. Scattered around the booth were small batteries such as are used in gasoline automobiles, and also batteries for electric vehicles. Various parts of battery equipment, such as insulators, connectors, separators, plates, syringes, etc., were tastefully arranged in a glass case. A standard switchboard for a storage-battery isolated plant occupied one corner of the booth. Those in attendance included Messrs. G. H. Atkin, J. Gay, G. R. Murphy, W. G. Bardens, H. S. March and J. W. Conley.

Eureka Vacuum Cleaner Company, Detroit, Mich., demonstrated a number of its vacuum cleaners. These cleaners are of the type having a small motor-driven centrifugal fan near the sweeper, with a bag for the reception of the dust attached to the handle. The various parts of the device were conveniently displayed on a table. The demonstrators in attendance were Messrs. F. Wardell and A. L. Generaux.

Federal Sign System (Electric), Chicago, Ill., utilized as the background for its booth a large sign of individual letters fitted with tungsten lamps and reading "Federal." Also forming part of the exhibition were the Federal vacuum cleaner, the Federal portable power table for general household use and samples of the company's clamp sockets, lock nut bushings and fittings. Messrs. J. H. Goehst and J. M. Gilchrist represented the company.

Fort Wayne Electric Works of General Electric Company, Fort Wayne, Ind., made a display of various types of kilowatt-hour meters, fans, small motors, vibratory massage machines and transformers for low-voltage circuits, besides a refrigerating machine. This latter is a motor-driven device having a brass cylinder within which is a sulphur-dioxide gas and a lubricant. Driven from the shaft to which the cylinder is attached is a small two-cylinder compressor which liquefies the sulphur-dioxide gas and forces it into a drum where it expands and gasifies. The sulphur-dioxide gas is returned to the compressor and the cycle continued again. The gasification of the sulphur dioxide of course causes refrigeration, according to well-known laws of physics. When used commercially the refrigerating cylinder revolves in a tank of brine, the latter

being circulated wherever desired. Messrs. F. S. Hunting, G. I. Kinney, W. R. Hendrey and H. L. Eicher represented the company.

FRANKLIN ELECTRIC MANUFACTURING COMPANY made a display at the background of its booth of tungsten lamps fitted with scientific glassware. Messrs. P. W. Huston and A. H. Jaeger were present.

GENERAL ELECTRIC COMPANY confined its exhibit to a selected line of material of interest to the delegates, the apparatus for the most part being shown in operation. A type-IRS induction regulator installed complete and rated at 34.5 kw was one of the operating features. A new combination color-matching outfit adopted widely by manufacturers of textile goods was shown for the first time. In one corner of the exhibit was an intensified arc lamp for alternating-current circuits, while in the other corner of the booth was the company's new long-life flame-arc lamp. On the southern terrace of the Armory were shown two of the luminous-arc lamps of the type now being adopted in many cities where the "Great White Way" idea has become popular. A comprehensive exhibit of various tungsten lamps was made and a practical exhibit of their performance was provided in the lighting of the exhibition hall. The General Electric heating and cooking devices were scattered throughout the booth, where the latest type of domestic ranges and other standard cooking apparatus were to be found. The "radiant" grill was given a place in keeping with its popularity since its appearance on the market a few months ago. Among the heavier apparatus displayed was a 25-hp mining-type motor and a 1-kw combination gasoline-driven generator set of a type used on yachts. An indicating type steam-flow meter was also on view. The staff in attendance included Messrs. J. R. Lovejoy, C. W. Stone, J. A. Cranston, T. E. Bibbins, R. J. Cash, Theodore Barron, R. E. Moore, H. L. Monroe, G. D. Rosenthal, C. B. Burleigh, C. H. Alexander, A. K. Baylor, F. G. Vaughen, M. O. Troy, N. R. Birge, D. B. Rushmore, E. E. Gilbert, F. H. Gale, A. D. Page, G. C. Osborne, R. B. Parker, F. W. Sanford, J. Howell, W. R. Burrows, C. M. Bliven, F. Stone, C. R. Wallas, J. W. Van Huysen, A. S. Heyward, R. N. Alvord, A. G. Jones, A. S. Moody, H. E. Duren, E. F. Whitney, H. Oliver, I. A. Shorno, H. A. Boring, E. C. Fellows, A. D. Pritchard, J. L. Wright, S. E. Mitchell, F. J. Zorn, C. P. Deming and H. P. Cramer and Dr. Thomas Addison.

Views of Exhibits at N. E. L. A. Convention.

GENERAL VEHICLE COMPANY, Long Island City, N. Y., displayed a number of photographs and distributed literature showing the various classes of electric vehicles manufactured by it. Literature giving in detail the advantages of the electric vehicle for city delivery and general service was available. Mr. C. W. Hutton represented the company.

G & W ELECTRIC SPECIALTY COMPANY, Chicago, Ill., showed four display boards on which were mounted various types of potheads and junction boxes for tensions ranging from 3000 volts to 30,000 volts. A combination of pothead and junction box employing either a closed fuse or a knife switch for disconnecting purposes formed part of the exhibition. Mr. G. P. Edmonds was in attendance.

Hubbard & Company, Pittsburgh, Pa., displayed a line of pole-line hardware including Pierce all-steel brackets and pins and models of the Pittsburgh Reinforcing Pole Company's method of reinforcing decayed poles. Representing the company were Messrs. F. C. Todt, R. N. Dickinson and A. E. Boyles.

Hughes Electric Heating Company, Chicago, Ill., showed three electric ranges and three hot-plates. The feature of this stove is that all cooking is performed on a directly exposed element, which is readily renewable and possesses three heats. The oven of the range is designed on the fireless-cooker plan. Inasmuch as the general make-up of the Hughes stove is very generally known to the technical fraternity, a detailed description is unnecessary. Those in attendance were Messrs. G. A. Hughes, C. H. Weaver and B. R. Stare and Miss Reddington.

Hurley Machine Company, Chicago, Ill., displayed five types of electric washing machines, all of which are equipped with reversible wringers. These washing machines are designed with revolving cylinders and are known as the "Thor" electric, the "Red" electric and the "Copper" electric. Messrs N. Hurley and E. N. Hurley, Jr., explained the merits of the different machines.

H. W. Johns-Manville Company, New York, N. Y., had on exhibition in the back of its booth a complete line of "Noark" high-tension and low-tension protective devices, junction boxes, fuses, etc. Samples of fiber conduit for underground circuits, asbestos-covered wires, asbestos board, insulators, etc., were also arranged in the company's booths. Featured was a new line of meter protective devices, within which are meter-testing blocks so arranged that the meter may cut out without interfering with the customer's service, enabling the meter to be tested after the usual fashion. As a part of this system the company has a meter-testing plug, by means of which the proper connections may be made instantly and correctly. Samples of friction tape, insulating sockets, strain insulators and the various products manufactured by the company were also shown. Conspicuous in one corner of the booth was an "Audiffren-Singrun" refrigerating machine. The refrigerating apparatus itself is manufactured by the Fort Wayne Electric Works of the General Electric Company and is described in connection with the exhibit of that company. This machine was operated in connection with a large refrigerator, in the center of which was the brine tank. An ice-freezing tank was also connected to the machine. The Sierra high-tension oil switch and series transformer were displayed in the booth of the H. W. Johns-Manville Company. Representing the company were Messrs. J. W. Perry, J. C. C. Morris, F. S. Mills, S. P. Russell, R. C. Cole, W. E. Wright, G. G. Gunderson, F. W. Doty, B. Hatton, G. A. Saylor, V. A. Wellman, H. G. Petersen, D. A. Boylan, I. T. De Silva and F. W. Loomis.

Metropolitan Engineering Company, Brooklyn, N. Y., displayed a complete line of Murray porcelain apparatus, including meter protective devices, meter seals, service switches and cut-outs, meter testing plugs, renewable fuses, panelboards, subway cut-outs and branch plugs, inclosed primary fuse and high-tension cut-out for pole line and subway work, high-tension series cut-out and switch for arc lamps, subway cable racks, etc. In the Murray system nothing is left to the chance of human carelessness, and the circuit cannot be made unless all of the contacts are inclosed in porcelain. Devices have been short-circuited standing in gasoline with the upper or fuse part in a gasoline atmosphere, thus demonstrating the security afforded by the system in hazardous locations. The meter protective device is well known, having been described in the reports of the meter committees of the various national bodies. Messrs. T. E. Murray and P. E. Brown were present during the convention.

Minerallac Electric Company, Chicago, Ill., made a display of its insulating materials, including high-tension and low-tension paints, wood bushings, insulators, tapes and varnishes. In the front of the booth were displayed a maxicator and a universal maxometer, the former for use on loads up to 50 hp and the latter for connected loads above 50 hp. The maxometer has been developed for use with standard watt-hour meters, to which they are interlocked electrically. The impulses transmitted to the maxometer are made through a standard contact-making commutator which is mounted upon one of the spindles of the meter register. The circuit of the solenoid contained within the maxometer is closed by the commutator at a rate proportional to the consumption of energy. The solenoid drives two pointers, one known as the setback pointer and the other as the friction-indicating pointer. During the forward motion the setback pointer drives the friction pointer at exactly the same rate, but at the end of a half-hour interval the setback mechanism is raised and the first pointer is returned automatically to zero, the friction pointer remaining at its former position. The setback pointer is then reengaged with the advancing mechanism and the cycle is continued every half hour. By this means and without the use of a clock mechanism the maximum demand per half-hour interval on any installation is readily obtainable. The Minerallac printometer, described in these columns some time ago, was also featured. Those in attendance were Messrs. H. S. Sines and C. N. Arnold.

National Electric Lamp Association's Engineering Department occupied a booth in the northwest corner of the hall, the prominent feature of which was a large tree-shaped bronze fixture bearing various sizes of tungsten lamps fitted with prismatic glassware. Tungsten lamps of all regular sizes for commercial lighting circuits were shown in a case illuminated by forty sign lamps. In another case was displayed a line of tungsten miniature lamps for voltages ranging from 2 to 30. The case contained in addition the new tungsten 10-watt, 100-130-volt and the 5-watt, 50-65-volt sign lamps, which were shown for the first time. In one corner of the booth was a full-sized section of the testing racks in use at the Engineering Department, shown in operation. A large number of decorative lamps and units made up of different forms of illuminating glassware completed the exhibit. Among those in attendance were Messrs. J. R. Crouse, H. A. Tremaine, S. E. Doane, W. M. Skiff, W. Harrison, L. S. Twomey, R. Beman, R. E. Campbell, J. A. Vendergrift, H. Eisenmenger and E. H. Houghton.

Otis Elevator Company, Yonkers, N. Y., distributed literature devoted to its traction elevators, residence elevators, escalators, etc. The various working parts of the Otis system of elevators were described in a catalog especially prepared for that purpose. Those in attendance were Messrs. R. W. Charles, R. J. Huntington, J. C. Bebb and R. A. Parks.

Pacific Electric Heating Company, Ontario, Cal., made a complete display of its line of electric heating appliances, including the well-known hot-point irons, chafing dishes, coffee urns and toasters. Tailor irons, laundry irons, foot-warmers, heaters, traveling sets and electric grills were also shown. Electric emersions and water heaters, heating pads, etc., were displayed to advantage in the large space occupied by the company. Representing the company were Messrs. F. Booth, H. T. Van Riper, J. N. Bowden and H. T. McCrea.

Philadelphia Electrical Manufacturing Company, Philadelphia, Pa., displayed an iron standard in the center of its booth, to which were attached the various styles of tungsten arc lamps manufactured by the company. Attached lower down on the standard were samples of "Pemco" incandescent street-lighting fixtures and absolute cut-outs. Mr. C. L. Bundy was present.

SIMPLEX ELECTRIC HEATING COMPANY, Cambridge, Mass., showed a line of electric cooking and heating apparatus, including a range and a complete assortment of irons, chafing dishes, waffle irons, toasters, water heaters, heating pads, etc. Those in attendance were Messrs. G. Young, F. G. Larkin, F. H. Smith and J. I. Ayer.

WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., had a number of its motors on exhibition and featured the rectifier built by it for charging automobile ignition batteries from alternating-current circuits. In one corner of the booth was a single-phase converter and switchboard for electric-vehicle battery-charging circuits. These outfits are built in ratings ranging from 2 kw to 5 kw. Representing the company were Messrs. F. N. Jewett, J. Mustard, A. T. Myers, T. S. Clark, F. R. Bates and R. D. Lillibridge.

WAVERLEY COMPANY, Indianapolis, Ind., showed an electric pleasure vehicle. The company was represented by F. T. Bird.

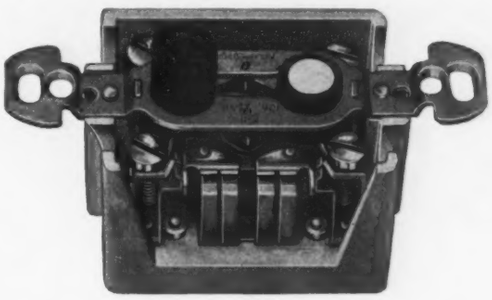
WESTERN ELECTRIC COMPANY, Chicago, Ill., occupied a booth in which were a number of fans and domestic appliances, together with an intercommunicating telephone set. The booth was employed chiefly for reception purposes, and in attendance were Messrs. F. B. Gleason, P. J. Aaron, Carl Bush, L. Brown, M. H. Nichols, F. Parrish and A. L. Phillips.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pittsburgh, Pa., made a very complete display of its machinery, apparatus and instruments. The new line of fan motors brought out by the company and its complete line of electric heating apparatus were on view; also various types of watt-hour meters and precision meters. Within the booth was shown the make-up of the carbon flame-arc lamps for constant-current service, twelve of which were used to illuminate the street in front of the Armory. A line of the tungsten lamps built by the Westinghouse Lamp Company was also displayed, and styles of the metallic flame arc built by the Westinghouse Electric & Manufacturing Company. Near one end of the booth was shown a condenser-type terminal for 88,000-volt outdoor service or 110,000-volt indoor service. The exhibit as a whole was arranged around the outside of the large space contracted for by the company, the interior of which was ample for entertaining the guests of the company. The overflow of heavy apparatus was shown in a separate booth. The company was represented by Messrs. G. E. Tripp, L. A. Osborne, S. L. Nicholson, W. W. Briggs, C. S. Cook, G. B. Griffin, J. C. McQuiston, A. A. Brown, W. S. Rugg, J. J. Gibson, J. A. Brett, T. P. Gaylord, C. E. Heise, K. E. Van Kuran, A. Tobias, J. W. Busch, G. W. Ewing, Stephen Gardiner, S. Q. Hayes, A. M. Irwin, W. D. McDonald, B. S. Manuel, T. J. Pace, E. A. Thornwell, J. S. Tritle, L. L. Warfield, G. R. Sailor, F. N. Kollock, Jr., A. A. Miller, H. T. Robeshite, L. C. LaMont and T. G. Whaling.

WESTON ELECTRICAL INSTRUMENT COMPANY, Newark, N. J., made a very complete and interesting display of all types of instruments manufactured by it. The operation of the company's synchroscope, frequency meter, wattmeter, power-factor meter, ammeter and voltmeter was shown in connection with motor-generator sets and a device for giving a varying load at the switchboard. The arrangement subjects the instruments to a very severe test and demonstrates their dead-beat qualities and the rapidity with which they respond to violent fluctuations. Forming part of the exhibit was a 20,000-amp ammeter with illuminated dial of the type employed for indicating the total current output of large systems. One case contained a complete line of new portable and switchboard instruments for direct-current service. Those in attendance were Messrs. F. F. Smith and A. Honeychurch.

FLUSH SWITCH.

The flush switch here shown has been built without a rotating member, use being made of a simple reciprocating mechanism. The stroke of the button is short and in a straight line. The wearing parts of the mechanism are



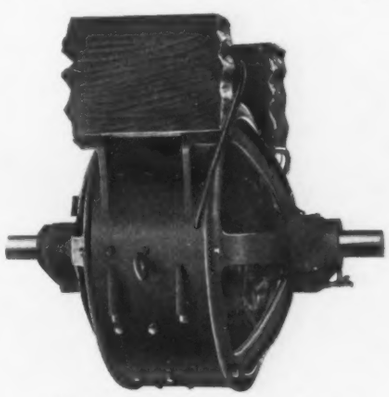
Flush Switch.

polished steel balls on brass surface, the balls giving a true balance of spring pressure.

Pushing the "on" button brings the contact piece forward, while pushing the "off" button breaks the contact with a sharp snap. The contact piece breaks the circuit at four points on each side. The rating is 10 amp, 250 volts. The mechanism is inclosed in a casing made of molded insulating material developed in the ceramic laboratory of the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., which has placed the switch on the market.

MOTOR FOR CEILING SUSPENSION.

Herewith is illustrated a motor suitable for ceiling suspension and direct coupling to line shafts. The motor is of the commutating-pole type with bearings carried in rigid six-arm bonnets and the frame divided horizontally, there being eye bolts on each side with tap holes in both parts of the frame, so that the entire motor may be conveniently lifted in place and, if necessary, the lower part can readily be removed. Particular attention has been paid in the design to giving an extra heavy shaft with very liberal bearing surface, yet by the use of a steel frame and by taking the fullest advantage of the commutating-pole feature an extremely light and compact design has been obtained. The 50-hp, 200-r.p.m. motor here shown has a net

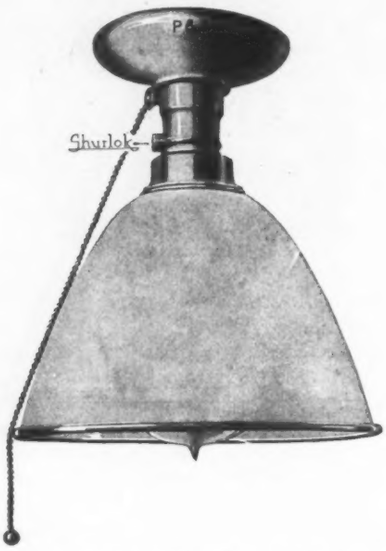


Motor for Ceiling Suspension.

weight of approximately 7000 lb. and therefore required far less special construction in connection with the roof truss from which it is supported than would be the case with the ordinary slow-speed motor, the weight of which would be in excess of 10,000 lb. This motor has been developed by the Diehl Manufacturing Company, Elizabethport, N. J.

CHAIN-PULL RECEPTACLE WITH LAMP-LOCKING ATTACHMENT.

Herewith is illustrated a lighting fixture combining a chain-pull receptacle, lamp-locking device and prismatic reflector. The so-called "shurlok" protects from removal not only the lamp but the reflector as well, because with the

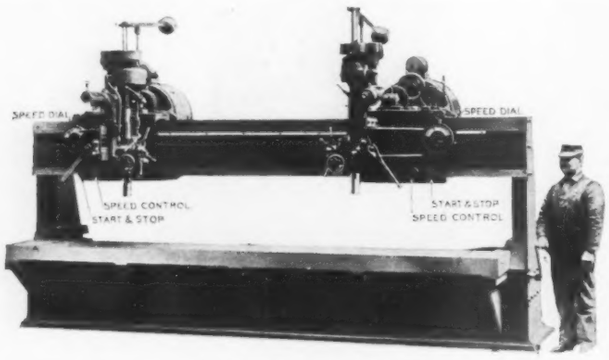


Chain-Pull Receptacle with Lamp-Locking Attachment.

lamp locked in place the reflector cannot be removed. The locking attachment is unobtrusive and can be operated only by means of a special key of peculiar triangular shape. This device has been developed for the market by Pass & Seymour, Inc., Solvay, N. Y.

DIRECT-MOTOR-DRIVEN DRILL.

The accompanying illustration shows a heavy-duty drill with a wide speed range directly driven by a 7.5-hp variable-speed motor. The motor is of the armature-shifting type and has a speed range of from 200 r.p.m. to 1600 r.p.m. The shifting of the armature is accomplished by a small motor mounted on the top of the driving motor and con-



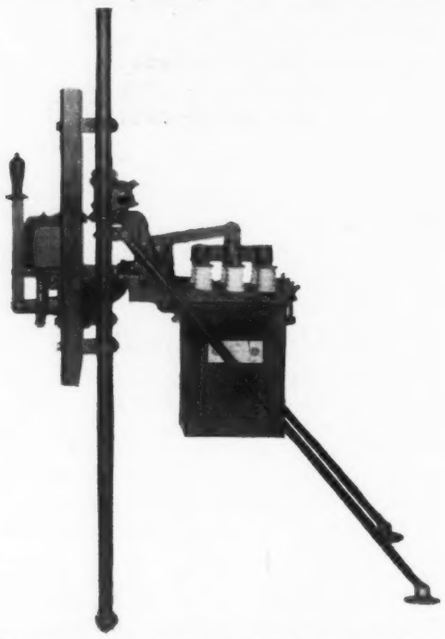
Electrically Driven Drill.

nected to the shifting mechanism through sprockets and chain. To vary the speed the operator simply presses the "fast" or "slow" button of the speed control, which is conveniently located. The drill is also equipped with a speed dial provided with two scales, one showing the cutting space and the other various sizes of drills. The dial is first set for the cutting speed desired and the speed of the motor is then adjusted until the pointer is opposite the size of drill to be used.

This drill is manufactured by the Foote-Burt Company, Cleveland, Ohio, and the electrical equipment is furnished by the Reliance Electric & Engineering Company, Cleveland.

OIL SWITCH.

It is claimed that the oil switch herewith illustrated, as developed for voltages up to 7500, contains every feature necessary for reliability and long-continued successful operation. The switches are made non-automatic and automatic, hand and solenoid operated, and for mounting on switchboard panel, panel pipes, pipe framework, flat surfaces or in cells. Automatic tripping on predetermined abnormal conditions is accomplished by series transformers and relays



Triple-Pole, Single-Throw 7500-Volt Oil Switch.

for all voltages or by series trip coils on the switches themselves for potentials up to 2500 volts. The double-throw switches consist of two single-throw units with a common frame and oil vessel. The operating levers are equipped with a single mechanical lock so arranged that only one set of contacts can be closed at one time.

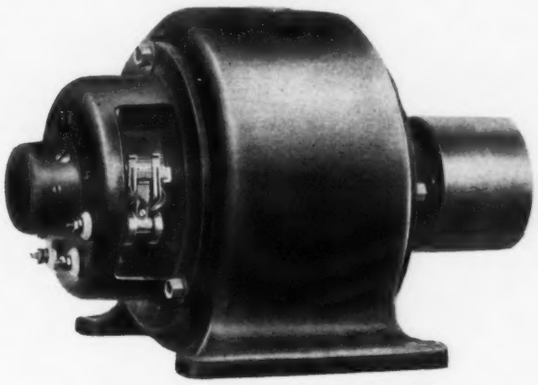
This line of switches has been introduced by the General Electric Company, Schenectady, N. Y.

SHUNT-WOUND MOTORS FOR TRACK WORK.

Almost all motors used on railway circuits are series-wound, thus having a speed which decreases with increasing load. The series winding is of great benefit in protecting the motor from sudden fluctuations in voltage and other disturbances in railway circuits. In case constant speed is wanted, irrespective of the load, shunt-wound motors must be used. Such a motor operated on an ordinary grounded railway circuit is subject to very severe conditions, and special precautions must be taken in its construction.

The Railway Track Work Company, of Philadelphia, is operating some 3.5-hp shunt-wound motors for driving track grinders on 550-volt direct-current railway circuits, which motors are said to have withstood the severe service very well. These motors, which are exposed to the weather,

dirt, dust and grit, are equipped with specially designed bearings with spring covers on the oil-well openings and with caps to prevent the entrance of any foreign material. The field coils are wound with specially insulated wire having a coating of high-resistance, heat-proof and waterproof enamel in addition to the ordinary cotton covering. The field coil and the armature are completely and solidly



Shunt-Wound Motor for Track Work.

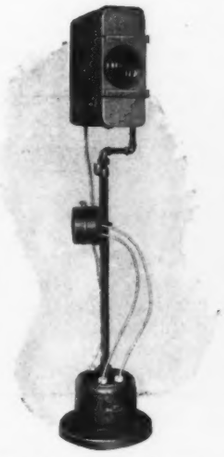
filled with insulating gums by the process of vacuum impregnating. The motors were manufactured by the Crocker-Wheeler Company, Ampere, N. J.

ARC-LAMP TRANSFORMER.

The device illustrated herewith is known as the "transpotarc," and, as its name suggests, is a transformer for "spot-light" arc lamps. The "spot" and "flood" lamps in general use in all well-equipped theaters require an emf of 35 volts at the arc, such voltage usually being obtained from the commercial 110-volt or 220-volt lighting circuits by the insertion of a rheostat in series with the lamp. The use of the series resistor is very wasteful of energy. The "transpotarc" has been designed to eliminate the electrical energy formerly wasted as heat.

The device is rated at 1.5 kw and for use on either 110-volt or 220-volt, 60-cycle or 133-cycle circuits. It is similar in constructive material to high-voltage transformers. The core is made from silicon steel. Both the core and the coils are first insulated and then impregnated with a waterproof compound by means of the vacuum treatment.

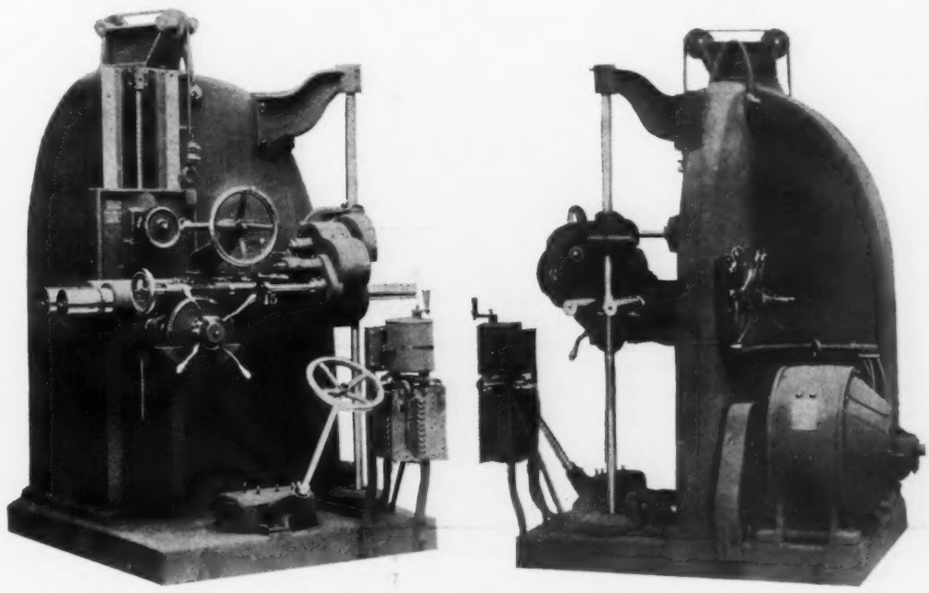
The electrical proportions are such that if the lamp terminals be short-circuited the current will rise by only a small amount above normal. With the "transpotarc" there can therefore be no dangerous flow of current under any possible condition of service. The transformer serves as a base for the lamp, being especially adapted to the standard pipe support used on the usual "spot" and "flood" lamps. The device has been placed on the market by the Fort Wayne Electric Works of the General Electric Company, Fort Wayne, Ind.



Arc-Lamp Transformer.

LARGE ELECTRICALLY DRIVEN RIVETING MACHINE.

For the final riveting of the enormous lock gates at the Panama Canal the McClintic-Marshall Construction Company, of Pittsburgh, has installed sixteen special electrically operated machines for drilling and reaming rivet holes. The machines are designed to run on a standard-gage track and are mounted on broad adjustable scaffolds which are suspended from brackets by chains from the top of the gate. The inclined hand-wheel shown in Fig. 1 operates through a train of gears and moves the machine along the track. The horizontal hand-wheel actuates suitable reduction gearing and a screw which raises or lowers the spindles, while the quick-return motion is actuated by means of a spider hand-wheel. Each machine can be operated at four speeds which are instantly available through the quick-change gear mechanism, and the spindles can be fed independently. A clutch lever is provided for placing either spindle in operation, while the feed lever is seen in Fig. 1, just above the clutch lever, through the hand-wheel. A direct-current, adjustable-speed, shunt-wound motor, rated at 10 hp, 220 volts, is used. It is stated that on tests made at Gatun one of the machines drilled 1 1/16-in. holes through 1-in. plates in four seconds, or at a rate of 15 in. per minute. These machines are built by the Foote-Burt Company, of Cleveland, Ohio. The electrical equipment was furnished by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.



Figs. 1 and 2—Electrically Driven Riveting Machine.

Industrial and Financial News

UNMISTAKABLE signs that business is holding its own in the face of political and labor unrest may be found in the increases recorded recently in bank clearings, in railroad earnings and in the country's foreign trade. A gain of over 10 per cent was made last week in bank clearings; an increase of nearly 7 per cent in gross railroad earnings for June was indicated by the returns in the first week of the month, and the value of foreign trade in the month of May, according to a statement issued this week by the government, was not only greatly in excess of that in May, 1911, but was larger than that in any corresponding period in the past five years. Reflection upon the proportions of the trade movement indicated by these additions to the huge volume of business always effected of necessity throughout the country should set at rest any uneasiness as to the outlook for the remainder of the year. With the lessening of political clamor after nomination of the presidential candidates, there seems to be no good reason why an early response to the favorable influences now existing in commercial lines should not be made. Pending this briskness, however, the money market is relatively quiet. Rates June 19 were: Call, 2½@2¾ per cent; ninety days, 3@3¼ per cent.

Patent Decision Clears Way for Wireless Merger.—A decision handed down by the United States Circuit Court of Appeals at Boston on June 18 in favor of the United Wireless Company in a suit which was brought against it by the National Electric Signalling Company for alleged infringement of patents granted to Reginald A. Fessenden and controlled by the National company makes possible the merger of the United Wireless Company with the Marconi Wireless Telegraph Company of America, as sanction for the consolidation of these two companies has been withheld by the federal courts pending settlement of this suit. The decision of the United States Circuit Court of Appeals in this case reverses a decision handed down on Sept. 21, 1911, by Judge Hale at Portland, Maine, sustaining the claims of the National Electric Signalling Company to Patent No. 706,736, granted to Mr. Fessenden Aug. 12, 1902. Suit has been brought by the Marconi company against the Signalling company on the ground that the Fessenden patents are an infringement on rights granted to Mr. Marconi. Reorganization of the United Wireless Company is progressing smoothly, and holders of 600,000 shares of the company's stock have paid the assessment of 50 cents per share agreed upon under the reorganization plan. The $300,000 obtained from this source has been used by the reorganization committee to purchase all of the assets of the United company from the trustees in bankruptcy. These have been sold to the Marconi company for 140,000 shares of its capital stock of the par value of $5 per share. The Marconi company is planning to erect a receiving station at Glace Bay to work in conjunction with the sending station which it has there.

Foreign Capital for Aluminum Manufacture in North Carolina.—The Banque Franco-Americaine, of Paris, and the Bank Leu & Company, of Zurich, are the promoters of a new corporation, known as L'Aluminum Française, which has been organized in Paris with a capital of 15,000,000 francs to manufacture aluminum in this country. The Southern Aluminum Company, capitalized at $8,000,000, will be the operating company. Properties of the North Carolina Electric & Power Company, near Whitney, N. C., where there are large deposits of bauxite, used in the manufacture of aluminum, have been purchased by the foreign syndicate, which will locate its plants at that place. This purchase includes land, houses, dams and a partly completed hydroelectric plant, which has a rated output of 50,000 hp. Ownership of some 7,200 acres of land in Whitney and along the Yadkin River is retained by the North Carolina company. This corporation, of which Laurence H. Sanders, 2 Rector Street, New York City, is president, resulted from the reorganization of the Whitney company in 1911. While all financial details have not been completed, it is understood that the foreign syndicate will pay $750,000 in cash and $500,000 in stock of the Southern Aluminum Company for the properties. Dr. P. Héroult, of 149 Broadway, New York, is now in Whitney, representing the foreign interests in the transaction.

Ohio Telephone Merger Contemplated.—Announcement has been made that the Ohio Public Service Commission would consider this week plans for the consolidation of the telephone companies in Ohio controlled by J. P. Morgan & Company with those of the American Telephone & Telegraph Company in that State. Such consolidation would mean the elimination of the dual telephone system now operated, with many disadvantages, in the territory served by these companies: The independent companies concerned, which came under Morgan control about four years ago, are the Cuyahoga Telephone Company, the Columbus Citizens' Telephone Company, the Toledo Home Telephone Company, the Home Telephone Company of Dayton, and the United States Telephone Company. With their subsidiaries, these companies furnish service to over 1,500,000 people in Ohio, the long-distance lines of the United States Telephone Company, which has furnished the principal opposition to the Bell system, reaching nearly every county in Ohio, excepting Hamilton, and practically all the important cities and towns excepting Cincinnati. In all the cities served, with the exception of Cleveland, the Morgan companies meet competition from the Central Union Telephone Company, which is controlled by the American Telephone & Telegraph Company.

Public Utility Securities Listed.—The following public utility securities have been listed on the New York Stock Exchange: Standard Gas & Electric Company, $10,300,000 convertible 6 per cent sinking-fund bonds; American Cities Company, $20,553,500 6 per cent cumulative preferred stock and $16,264,700 common stock; Ontario Power Company of Niagara Falls, $8,272,000 first-mortgage 5 per cent sinking-fund forty-year bonds, due 1943; Chicago Telephone Company, $14,000,000 first-mortgage fifteen-year 5 per cent gold bonds, due 1923; Havana Electric Railway, Light & Power Company, $15,000,000 6 per cent cumulative preferred stock and $15,000,000 common stock.

General Bakelite Company Starts Infringement Suits.—The General Bakelite Company, of 100 William Street, New York, manufacturer of insulating substances, has brought suits for infringements of its Bakelite patents against the Condensite Company of America and several users of "Condensite," among them the Dickinson Manufacturing Company, of Springfield, Mass.; the Duranoid Manufacturing Company, of Newark, N. J., and Hardman & Wright, of Belleville, N. J. Fundamental Bakelite patents have been allowed in Germany and have been sustained by the German Patent Office.

New Doherty Holding Company Formed.—The Consolidated Cities Light, Power & Traction Company has been incorporated under Delaware laws by H. L. Doherty & Company. The new concern will be a holding company for a number of public-service corporations in which the incorporators are interested. It will have a capital stock of $10,000,000, of which $5,000,000 will be issued at present. There will also be an authorized issue of $25,000,000 bonds, of which only a small amount will be outstanding at this time. The outstanding securities have been underwritten by foreign interests.

Central Maine Power Company Obtains Water Rights.—The rights of the State Trust Company, of Augusta, Maine, to power sites and other lands in the towns of Clinton, Canaan and Skowhegan, Maine, formerly held by the George S. Ricker Company, have been acquired by the Central Maine Power Company, of Waterville, Maine. Among the properties acquired are certain flowage rights along the Carrabasset, mills and mill privileges on the Sebasticook River in Clinton, and about 1200 acres of timber land in Canaan, Skowhegan and Hartford.

Idaho Public Utility Companies Merged.—Kissel, Kinnicut & Company, bankers, New York, with several other New York interests, have formed a corporation under the laws of Maine, known as the Idaho Railway, Light & Power Company, which is a merger of several electric railway, light and power companies operating in and near Boise, Idaho. The authorized capital of the new company is $30,000,000, of which $20,000,000 is common and $10,000,000 is 6 per cent non-cumulative preferred stock. A majority of both the $7,485,700 outstanding common stock and the $2,491,600 preferred stock of the Idaho-Oregon Light & Power Company, of Boise, has been acquired by the new company, together with about $1,443,000 of its consolidated first and refunding mortgage 6 per cent gold bonds, there now being, aside from this amount, only some $170,000 of this issue outstanding. In addition to these securities, the Idaho Railway, Light & Power Company has acquired a 4000-kw hydroelectric plant on the Snake River, Idaho, formerly owned by the Swan Falls Power Company, of Nampa, Idaho, energy being furnished from this plant to the Idaho-Oregon Light & Power Company. The property and franchises of the Dewey Electric Light & Power Company, Ltd., of Nampa, Idaho, the holdings of the Caldwell Power Company, of Caldwell, Idaho, and those of several interurban railways operating in and near Boise, Nampa and Caldwell, including those of the Boise & Interurban Railway, have also been taken over by the new company. Its directors are Albert H. Wiggin, president of the Chase National Bank, New York; Charles H. Sabin, vice-president of the Guaranty Trust Company, New York; John D. Ryan, president of the Amalgamated Copper Company; Robert W. Watson, managing director Great Northern Power Company; William Mainland, president Idaho Railway, Light & Power Company; Sinclair Mainland, director Idaho-Oregon Light & Power Company; R. M. Burtis, president Interstate Power Company, Oshkosh, Wis.; Stacy C. Richmond, Winslow, Lanier & Company; Samuel L. Fuller, Kissel, Kinnicut & Company; A. E. Thompson, Oshkosh, Wis., and Grant Fitch, vice-president National Exchange Bank, Milwaukee, Wis.

Financial Matters Before New York Commission.—The Public Service Commission for the Second New York District has received a petition from the Adams (N. Y.) Electric Light Company asking for permission to take over all of the property and assets of the Adams Electric Light Company, Ltd., including franchises. The petition also asks for the necessary approval of franchises, permission to commence construction, and authority to issue $30,000 of bonds, the proceeds from which are to be used for making improvements and betterments, and $18,000 of its common capital stock for the purchase of the property and assets of the Adams Electric Light Company, Ltd. The Second District Commission has received notification from the Skaneateles Telephone Company that it has sold and conveyed its physical property and business to the New York Telephone Company for the sum of $20,700.

Cincinnati & Suburban Bell Telephone Financing.—Authority has been granted to the Cincinnati & Suburban Bell Telephone Company by the Ohio Public Service Commission to issue $580,000 additional capital stock for the purpose of providing a new central exchange building and switchboard of sufficient size to take care of its business more effectively. The company has an authorized capital stock of $8,000,000, but only $7,058,050 has been issued. The remainder has been held in the treasury for the purpose of making improvements and furnishing funds for working capital when needed, as in the present case. The Newark Telephone Company, Newark, Ohio, has received permission to issue bonds to the amount of $140,000. Most of the funds secured from the sale of the bonds will be used to liquidate indebtedness.

United States Rubber Declares 20 Per Cent Special Stock Dividend.—Directors of the United States Rubber Company at a special meeting on June 18 declared, in addition to the usual quarterly dividends of 2 per cent on the first preferred stock, 1½ per cent on the second preferred stock and 1 per cent on the common stock, an extra stock dividend of 20 per cent on the common stock. This requires the issuance of 50,000 shares of common stock at par to the holders of the $25,000,000 of that issue outstanding at present. Resolutions were also passed providing for the offering of 100,000 shares of first preferred stock at par to all the holders of the three classes of stock to the extent of 12½ per cent of present holdings.

Tennessee Railway, Light & Power Meeting.—Stockholders of the Tennessee Railway, Light & Power Company are to hold a special meeting on June 26 at Portland, Maine, to approve a contract under which the Tennessee Securities Company issued common and preferred stock of the Tennessee Railway, Light & Power Company, and a contract between the syndicate managers and the Tennessee Railway, Light & Power Company by which the latter guarantees payment of principal and interest of first-mortgage fifty-year 5 per cent bonds of the Tennessee Power Company.

American Public Utilities Company Organized in Chicago.—A new company, known as the American Public Utilities Company of Chicago, has been organized under Delaware laws to manufacture and deal in natural and artificial gas, to deal in stocks, bonds, etc., and to construct and operate public utility systems of various kinds. The incorporators are Paul Neufter, Harry E. Phillips, Charles J. Horn and Burrell Cramer, of Chicago, and William J. Maloney, of Wilmington, Del.

Westinghouse Machine Meeting.—While the date for the annual meeting of stockholders of the Westinghouse Machine Company falls on June 25, a letter sent to the stockholders by T. S. Grubbs, secretary of the company, intimates that the meeting will be adjourned pending "consummation of certain important transactions, which will result in a substantial reduction in the amount of the company's outstanding obligations, and otherwise favorably affect its financial situation."

Purchase Flowage Rights on Kennebec River.—The Umbagog Paper Company, of Embden, Maine, a subsidiary of the International Paper Company, has purchased over 300 acres of land distributed on both sides of the Kennebec River, in Maine, extending about 8 miles above Umbagog Falls. With the flowage rights thus obtained, the company will make extensive additions to its manufacturing facilities, including enlargement of its present generating equipment to 20,000 hp.

Philadelphia Company Increases Common Dividend Rate.—A quarterly dividend of 1¾ per cent on its common stock has been declared by the Philadelphia Company, of Pittsburgh. This is payable Aug. 1 to holders of record July 1. A regular dividend of 1½ per cent has been paid on this issue quarterly since 1901, and extra dividends of 1 per cent were paid on it in 1910 and 1911, placing it on a 7 per cent basis for those two years.

McCrum-Howell Receivers' Certificates Authorized.—Permission has been granted to the receivers of the McCrum-Howell Company to issue not exceeding $500,000 first-lien receivers' certificates, the proceeds of which are to be used for carrying on the business. The receivers have also been authorized to enter into certain contracts relating to patent rights held by the company for the manufacture of vacuum cleaners.

American Gas & Electric Increases Dividend.—A quarterly dividend of 1¾ per cent on its common stock, payable July 1, has been declared by the American Gas & Electric Company. This is an increase of one-quarter of 1 per cent over the previous payment and places the stock on a yearly basis of 7 per cent.

Haverhill (Mass.) to Issue Stock.—Permission has been granted to the Haverhill Electric Company, of Haverhill, Mass., to issue 1117 shares of additional capital stock at a par value of $100. The proceeds will be used to pay off floating indebtedness incurred in construction and extensions.

Montgomery (Ala.) Light & Traction Notes Sold.—The Guaranty Trust Company, New York, has purchased $650,000 two-year 6 per cent secured gold notes of the Montgomery Light & Traction Company, of Montgomery, Ala.

Boston Edison Earnings.—In the month of May gross earnings of the Edison Electric Illuminating Company of Boston showed a gain of about $50,000, or 12.5 per cent over those in the same month of the previous year.

American Utilities Company's Holdings.—Incorporation of the American Utilities Company, under the laws of Delaware, as a holding company for a number of public service corporations in the Middle West, was effected recently. The companies which the new corporation will control are as follows: Utah Gas & Coke Company, Salt Lake City, Utah; Minnesota-Wisconsin Power Corporation; Boise Gas Light & Coke Company, Boise, Idaho; Valparaiso Lighting Company, Valparaiso, Ind.; Albion Gas Light Company, Albion, Mich.; Elkhart Gas & Fuel Company, Elkhart, Ind.; Winona Gas Light & Coke Company, Winona, Minn.; Holland City Gas Company, Holland, Mich., and Jackson Light & Traction Company, Jackson, Miss. The management will be in the hands of Kelsey, Brewer & Company, of Grand Rapids. The capitalization is as follows: Preferred stock, 6 per cent cumulative, authorized, $20,000,000; outstanding, $1,714,000; common stock, authorized, $20,000,000; outstanding, $2,400,000; collateral trust 5 per cent thirty-year bonds, $739,000. Earnings for the ensuing year based upon previous earnings of the various companies are estimated as follows: Gross earnings of all the properties, $1,112,440; operating expenses, including taxes and insurance, $578,469; interest on bonds and preferred stock of subsidiary companies, $261,625; interest on collateral trust bonds of the American Utilities Company, $36,950—these deductions leaving $235,396 as earnings accruing to American Utilities Company stocks. Williams, McConnell & Coleman, of New York, are offering $725,000 of the preferred stock and $290,000 of the common stock, in blocks of $1,000 par value preferred stock with $400 par value common stock, for $1,000. Kelsey, Brewer & Company are also offering these securities.

Platt Iron Works Reorganization.—Ample working capital and adequate funds for development and improvement have been provided for the Platt Iron Works Company, of Dayton, Ohio, through a reorganization plan that has been adopted by a large majority of the creditors of the company, which makes air-compressors, blowers, feed-water heaters, pumps and allied equipment. This plan is essentially the same as that outlined in the *Electrical World*, July 29, 1911. It provides for the formation of a new company in which all of the property now owned by the Platt Iron Works Company will be vested. This new company will authorize the following securities: (1) $1,000,000 face value first-mortgage 6 per cent twenty-year gold bonds; (2) $1,100,000 par value non-cumulative preferred stock, and (3) $1,000,000 par value common stock. The bonds are to be redeemable at the option of the new company on any interest date upon sixty days' notice, at 105 per cent of their face value and accrued interest. They will be secured by the new company's mortgage to the Central Trust Company, of New York, as trustee, on all the properties vested in it. It is intended to issue $700,000 of these bonds, of which $399,250 will be issued to depositing bondholders and $300,000 will be sold for cash. All stock is to be vested in a voting trust for a period of five years.

Maryland Telephone Merger.—The Maryland Public Service Commission has granted the Chesapeake & Potomac Telephone Company the right to buy the Diamond State Telephone Company, a corporation chartered under the laws of Delaware. This company is a subsidiary of the Bell company, and the transfer of its rights and privileges is a formal one required under the state public utilities law. The Diamond State company supplies service through the Bell lines to the Eastern Shore of Maryland and Delaware. Details of these companies were given in these columns May 25.

Niagara Falls Power Company to Issue Securities.—The Public Service Commission for the Second New York District has granted the application of the Niagara Falls Power Company to issue $3,567,000 in bonds or stock, to which reference was made in these columns June 8. The proceeds will be used for improvements, including work now under way.

Malden (Mass.) Electric Company to Issue Additional Stock.—Authority to issue $207,000 additional capital stock has been granted to the Malden Electric Company, of Malden, Mass., by the Board of Gas and Electric Light Commissioners.

REPORTS OF EARNINGS.

WEST PENN TRACTION & WATER POWER COMPANY.

The statements of earnings of the West Penn Traction & Water Power Company and subsidiary companies for the years ended March 31, 1912 and 1911, compare as follows:

	1912.	1911.
Gross earnings	$2,427,481	$2,059,227
Operating expenses and taxes	1,216,796	1,002,527
Net earnings	$1,210,684	$1,056,700
Fixed charges	707,933	613,321
Balance	$502,751	$443,379

Gross earnings in 1912 represent an increase of 17.8 per cent and net earnings an increase of 14.6 per cent as compared with the corresponding items in the preceding year.

CAROLINA POWER & LIGHT COMPANY, RALEIGH, N. C.

The income statement of the Carolina Power & Light Company for the month of May and for the twelve months ended May 31, 1912, compares with that for the corresponding periods of the previous year as follows:

May.	1912.	1911.
Gross earnings	$32,769	$27,721
Operating expenses and taxes	21,963	18,664
Net earnings	$10,806	$9,057
Total interest	8,040	6,654
Net income after charges	$2,766	$2,403
Twelve months ended May 31:	**1912.**	**1911.**
Gross earnings	$399,819	$339,031
Operating expenses and taxes	257,880	207,646
Net earnings	$141,939	$131,385
Total interest	92,432	73,116
Net income after charges	$49,507	$58,269

PACIFIC POWER & LIGHT COMPANY, PORTLAND, ORE.

The income statement of the Pacific Power & Light Company for the month of May and the twelve months ended May 31, 1912, compares with that for the corresponding periods of the previous year as follows:

May.	1912.	1911.
Gross earnings	$103,767	$99,378
Operating expenses and taxes	50,847	54,421
Net earnings	$52,920	$44,957
Total interest	24,229	27,471
Net income after charges	$28,691	$17,486
Twelve months ended May 31:	**1912.**	**1911.**
Gross earnings	$1,198,354	$1,146,173
Operating expenses and taxes	637,831	594,796
Net earnings	$560,523	$551,377
Total interest	338,893	234,552
Net income after charges	$221,630	$316,825
Preferred dividend	148,125	65,625
Balance	$73,505	$251,200

DAYTON (OHIO) POWER & LIGHT COMPANY.

The income account of the Dayton Power & Light Company, of Dayton, Ohio, for the month of May and the eleven months ended May 31, 1912, compares with that for the corresponding periods of the previous year as follows:

May.	1912.	1911.
Gross earnings	$49,599	$44,447
Operating expenses and taxes	25,777	25,641
Net earnings	$23,822	$18,806
Interest receivable	2,178	6
Total net earnings	$26,000	$18,812
Interest, etc.	17,050	15,250
Net income	$8,950	$3,562
Eleven months ended May 31:	**1912.**	**1911.**
Gross earnings	$607,875	$552,898
Operating expenses and taxes	318,948	321,703
Net earnings	$288,927	$231,195
Interest receivable	40,072	74
Total net earnings	$328,999	$231,269
Interest, etc.	188,388	162,554
Net income	$140,611	$68,715

PRICES IN THE NEW YORK METAL MARKET.

	June 11 Bid.	June 11 Asked.	June 18 Bid.	June 18 Asked.
Copper:				
Standard:				
Spot	16.70	17.25	17.00	17.37½
June	16.75	17.25	17.00	17.37½
July	16.75	17.25	17.12½	17.37½
August	16.80	17.25	17.12½	17.37½
September	16.80	17.37½	17.12½	17.37½
London quotation:	£ s d		£ s d	
Standard copper, spot	77 18 9		79 11 3	
Standard copper, futures	78 11 3		80 3 9	
Prime Lake	17.50		17.55	
Electrolytic	17.25		17.45	
Casting	17.12½		17.25	
Copper wire, base	18.25		18.50	
Lead	4.20		4.50	
Sheet zinc, f.o.b, smelter	8.65		8.65	
Spelter, spot	7.00		7.10	
Nickel	39.00 to 40.00		39.00 to 40.00	
Aluminum:				
No. 1 pure ingot	21 to 22		21 to 22	
Rods and wire, base	31		31	
Sheets, base	33		33	
OLD METALS.				
Heavy copper and wire	16.50		16.50	
Brass, heavy	10.25		10.25	
Brass, light	8.50		8.50	
Lead, heavy	4.25		4.25	
Zinc, scrap	5.75		5.75	

COPPER EXPORTS IN JUNE

Total tons, including June 11.....8,895 June 18.....14,377

STOCK MARKET PRICES

	June 12.	June 19.
Allis-Chalmers	¾	¾*
Allis-Chalmers, pf	2⅛*	2⅛*
Amalgamated Copper	85⅜	86⅜
Amer. Tel. & Tel.	145⅞	145⅞*
Boston Edison	285*	285*
Commonwealth Edison	138¼*	138¼
Electric Storage Battery	56	56½
General Electric	169	170½
Mackay Companies	87⅝*	88⅞
Mackay Companies, pf.	68⅝*	68⅝*
Philadelphia Electric	22¼	22⅛
Western Union	83¼	82⅞
Westinghouse	72½	73
Westinghouse, pf.	117 *	117 *

*Last price quoted.

Personal

Mr. Max W. Zable, patent attorney, Chicago, delivered an address before the Electric Club of that city on June 13, in which he strongly defended the existing patent laws.

Prof. J. M. Bryant, of the electrical engineering department of the University of Illinois, has been appointed electrical engineer for the Kankakee & Urbana Traction Company.

Mr. John Malm has been appointed city electrician for Denver, Col. Associated with Mr. Malm in the electrical inspection department will be Messrs. C. B. Thorn and B. Olliver.

Prof. William Edward Barrows, Jr., has severed his connection with the Armour Institute of Technology to accept the position of professor of electrical engineering at the University of Maine, Orono, Maine.

Mr. Edgar D. Sibley has resigned his position as assistant to the superintendent of power of the Brooklyn Rapid Transit Company to become associated with Mr. Walter G. Clark, consulting engineer, New York.

Mr. S. G. Meek, who has been associated with the H. W. Johns-Manville Company as special representative in the electrical department for a period of over fifteen years, has been appointed assistant general manager of that department.

Mr. R. J. Graf, secretary of H. M. Byllesby & Company, delivered an address on the relation between the finance department and other departments of the company at the first weekly luncheon of the Byllesby Lunch Club, held in Chicago on June 12.

Prof. Charles F. Scott, of the department of electrical engineering, Yale University, past-president of the American Institute of Electrical Engineers, has had the honorary degree of doctor of engineering conferred on him by Stevens Institute of Technology.

Mr. S. P. Grace, chief engineer and plant superintendent of the Central District & Printing Telegraph Company—the Bell telephone organization in Pittsburgh—was the chief speaker at a meeting of the Sons of Jove of Pittsburgh on June 13, his subject being telephone development.

Mr. George F. Brockman, who has been superintendent of the Union Light & Power Company, Minonk, Ill., has been appointed manager for the Public Service Corporation of Northern Illinois at Minonk, Rutland and Toluca, Ill. Mr. Brockman superintended the construction of electric lighting plants at Argenta, Ark., Ryan, Okla., and Wenoka, Okla., before locating at Minonk, Ill., in 1911.

Mr. C. E. Clewell, who has been illuminating engineer with the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has accepted a position in the department of electrical engineering in the Sheffield Scientific School of Yale University and expects to begin his new duties in the fall. Mr. Clewell has been associated with the Westinghouse company for three years, and during this time has been in charge of the design and installation of extensive lighting systems throughout the East Pittsburgh and other works of the company. He was recently transferred to the detail and supply department on illuminating engineering work, including the design of extensive lighting systems as well as research and test work. For the past two years he has been in charge of the illumination technical instruction section of the Westinghouse Club, and last year was elected chairman of one of the sections of the Westinghouse Progress Club. During the past few years Mr. Clewell has prepared papers relating to illuminating engineering subjects for the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and other engineering societies. He has also contributed liberally to the technical press. Since the formation of the Pittsburgh Section of the Illuminating Engineering Society he has served on the board of managers and on various committees of that society. For four years prior to his association with the Westinghouse Electric & Manufacturing Company he was engaged in instruction work in the department of electrical engineering at Lehigh University. Mr. Clewell will be associated with Dr. Charles F. Scott, professor of electrical engineering in the Sheffield Scientific School.

Obituary

Mr. William Northrop, president of the Virginia Railway & Power Company, Richmond, Va., died suddenly of heart failure on June 11 at his home near Forest Hill. Mr. Northrop was born in Pennsylvania forty-three years ago. He was educated at Philadelphia and at the University of New York, where he took the course in civil engineering. Shortly after graduation he accepted a position with the Philadelphia & Reading Railroad. In 1897 he led an expedition into the interior of Alaska. In 1902 he engaged in ranching in Montana. The Richmond Passenger & Power Company and the Richmond Traction Company were consolidated early in 1902, and the control of the consolidated properties passed in December, 1902, to the Gould interests. In the month following Mr. Northrop was appointed assistant secretary and assistant treasurer of the company and continued in this capacity until 1904, when he and Henry T. Wickham were appointed receivers. On July 1, 1909, the Virginia Railway & Power Company was organized as a successor to the Richmond Passenger & Power Company and Mr. Northrop was elected president of the company. Besides being president of the Virginia Railway & Power Company, Mr. Northrop was also president of the Norfolk Railway & Light Company and the City Gas Company of Norfolk, vice-president of the Richmond & Chesapeake Bay Railroad Company and president of the Fredericksburg Electric Company. He was a member of the Chamber of Commerce of Richmond and a director of the National Bank of Virginia. He is survived by a widow.

Construction

ATTALLA, ALA.—Application has been made to the Council by the Alabama Power & Development Company for a franchise to operate here.

GLENDALE, ARIZ.—Arrangements are being made to enlarge the municipal electric-light plant and extend the system. It is proposed to purchase energy from the government to operate the system. When improvements are completed a 24-hour service will be established and power will also be furnished to the nearby ranches for pumping and other purposes.

MIAMI, ARIZ.—The Inspiration Copper Co. will soon begin work on the erection of a new concentrator plant at Miami. A 7500-hp power plant will be installed to supply electricity throughout the works.

ARKADELPHIA, ARK.—Local capitalists are organizing a new telephone company for the purpose of installing a new telephone system here. The company will be capitalized at $25,000. R. B. F. Key, C. C. Henderson, T. N. Wilson and others are interested in the project.

GRAVETTE, ARK.—Bonds to the amount of $30,000 have been sold by the Water and Light Commission, the proceeds to be used for the installation of a water and light plant.

FRESNO, CAL.—The San Joaquin Lt. & Pwr. Co. has filed application with the State Railroad Commission for a certificate of public convenience and necessity to enable it to enlarge its distributing facilities. The company proposes to erect an additional transmission line for the purpose of augmenting its supply in the oil districts of Coalinga, Midway, Lost Hills, McKittrick and the Kern River fields. It also contemplates furnishing electricity in agricultural districts which are now without service.

GLENDALE, CAL.—The citizens of Glendale are asking E. D. Goode, the railroad builder of the valley, to build and operate an electric railway from Glendale to Los Angeles, offering to furnish a free right-of-way and bonus for such a railway.

GREENVILLE, CAL.—The Indian Valley El. Lt. & Pwr. Co. has begun work on the construction of its 20,000-kw plant at Seneca, on the Feather River. A temporary 750-kw plant will be erected near the head works to furnish power for construction work. A. C. Brunner is superintendent of operation.

LOS ANGELES, CAL.—Plans have been submitted to the Aqueduct Advisory Board by E. P. Scattergood, chief electrical engineer, for a municipal electric distributing system. To install a complete underground commercial and street-lighting system adequate to deliver electricity to every part of the city will cost, it is estimated, $16,574,500. For the installation of an overhead system to cover the same service the cost would be about $2,868,000. For a complete commercial underground system, not including street lighting, the cost is estimated at $12,754,300. For an underground street-lighting system, exclusive of commercial service, the cost would be $3,820,200. An overhead street-lighting system, not including commercial service, would cost $1,250,000. An overhead system for commercial purposes only would cost $1,618,000.

PORTOLA, CAL.—N. W. Davidson, Sacramento, who has purchased a hotel site and some improved property here, has made arrangements for the installation of an electric-light plant.

REDWOOD CITY, CAL.—Plans are being considered for the construction of an electric railway between San Francisco and South Peninsula points. H. C. Tuschen, Redwood City; William H. Brown, San Mateo; C. J. McGregor, Burlingame; D. G. Doubleday, Millbrae, and William J. Martin, South San Francisco, are interested.

RIVERSIDE, CAL.—The Southern California Utilities Co. has applied to the State Railroad Commission for permission to issue $10,000,000 in bonds. The company states that it proposes to sell water for irrigation purposes and intends to supply a tract of 30,000 acres in Riverside County. It has options on the property of the Ramona Pwr. & Irrigation Co., the Lake Hemet Wtr. Co., the Fairview Land & Wtr. Co. and the Hemet Town Wtr. Co. It is proposed to develop the property of the Ramona Pwr. & Irrig. Co., at a cost of $4,700,000.

SAN DIEGO, CAL.—The City Council has authorized the purchase of underground cable for its proposed fire alarm telegraph system.

SAN PEDRO, CAL.—The contract for the construction of a substation for the Southern California Edison Co., to be located at Olive and Mesa Streets, has been awarded to F. O. Engstrum Co., San Pedro. H. Alban Reeves is architect.

SANTA BARBARA, CAL.—The Coalinga Wtr. & El. Co., Coalinga, has applied for a franchise in Santa Barbara County and will erect transmission lines to Santa Barbara.

TROPICO, CAL.—The Sunset Tel. Co. has applied for a franchise to erect and operate a telephone system in Tropico.

BOULDER, COL.—The United States Gold Reduction Co. is equipping its plant for electrical operation. The equipment includes one 100-hp, 440-volt, three-phase General Electric induction motor for driving crushers, rolls, screens, elevators, etc.; one 30-hp induction motor for driving circulating pumps, ore precipitation pump, etc., and one 25-hp induction motor for fire pressure pump.

DENVER, COL.—The House of the Good Shepherd, Denver, is advertising for bids for equipment for a private plant, consisting of two 25-kw, 125-volt, direct-current generators, engines, boilers, etc. The plant will supply electricity to operate elevator motors and for lighting buildings.

NORTH CREEDE, COL.—A small water-power is being developed by several operating gold mine and mill companies at North Creede. Electricity is transmitted at 2300 volts for lamps and motors to the Creede United Mines Co., Humphreys Mining Co. and other mines.

STEAMBOAT SPRINGS, COL.—The Town Board has granted A. M. Gooding and associates a 20-year electric-light franchise.

MYSTIC, CONN.—The transformer station of the Mystic Power Company was destroyed by fire June 9, causing a loss of about $3,500.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 1 for furnishing lamp standards and brackets that may be required for various buildings under the control of the Treasury Department in accordance with drawings and specifications, copies of which may be obtained at the above office. James Knox Taylor is supervising architect.

WASHINGTON, D. C.—Prominent business men in a country of the Far East are interested in plans for an electric railway 35 miles long. An American consul writes that the promoters of the railway would like to receive prices showing in detail the cost of necessary machinery and equipment. Copy of complete report will be sent to parties interested on application to No. 9000, Bureau of Manufactures, Department of Commerce and Labor, Washington, D. C.

WASHINGTON, D. C.—Owing to a growing scarcity of fuel in a certain foreign country many mining companies are considering the advisability of establishing electric-power plants. The initial move has been made by a prominent local firm which contemplates the establishment of a large power plant to supply power for several mines. For further information address No. 8959, Bureau of Manufactures, Department of Commerce and Labor, Washington, D. C.

WASHINGTON, D. C.—The Secretary of the Interior has authorized the Reclamation Service to construct a temporary power plant, to be equipped with two units with a rating of about 400 kw each, at the St. Mary River crossing, and to build the canal from Kennedy Creek to the head of the proposed pressure pipe in connection with the St. Mary storage unit of the Milk River project. The Reclamation Service is also authorized to build a concrete pressure conduit under Kennedy Creek as part of the permanent St. Mary diversion canal and to acquire the necessary rights-of-way for the works proposed; also to erect telephone lines, electric transmission lines and roads necessary for the prosecution of the construction work on the St. Mary Canal and McDermott reservoir.

ST. AUGUSTINE, FLA.—The St. Johns Light & Power Company is contemplating extending its electric railway to New Augustine.

PENSACOLA, FLA.—The Board of Public Works has decided to install 25 additional lamps in different parts of the city.

AMERICUS, GA.—The stockholders of the new electric light and power company have organized and orders have been given to proceed with construction work. The entire amount of the capital stock, $50,000, has been subscribed.

COOLIDGE, GA.—An appropriation of $9,000 has been made for the installation of a municipal electric-light plant and water-works system. G. F. Knight is Mayor.

CORDELLE, GA.—Municipal ownership of the electric-lighting system in Cordelle is under consideration. It is proposed to operate the electric plant in connection with the municipal water-works system. The proposition to issue bonds for same will soon be submitted to a vote.

DALTON, GA.—Plans are contemplated for extensions to the municipal electric-light plant. It is proposed to install additional machinery to be used in case of emergencies.

GAINESVILLE, GA.—The Board of Public Works has submitted a proposition to the Gainesville Gas & El. Pwr. Co. offering to pay the company $35,000 for its electric-light plant.

MARSHALLVILLE, GA.—The installation of an electric-light plant and water-works system here is under consideration.

ABINGDON, ILL.—The City Council, in its ordinance appropriation, has included $15,000 for the installation of an electric-light plant.

ALTON, ILL.—The Pisa Lt. & Pwr. Co. has accepted the franchise to construct and maintain an electric-light system in Alton, recently granted by the city.

CAIRO, ILL.—Plans are being prepared by the Cairo Ry. & Lt. Co. for the construction of an addition to its power house, 68 ft. by 100 ft.

CENTRALIA, ILL.—The Centralia & Central City Trac. Co. has applied for a franchise to construct and operate its street railway on additional streets in this city.

CUBA, ILL.—The City Council has decided to sell the municipal electric-light plant. Bids for the plant will be received by Virgil Durand, city clerk, until Aug. 13.

HILLSBORO, ILL.—The Council of Taylor Springs has granted the Hillsboro El. Ry. Co. a franchise to use the city street for its interurban railway between Hillsboro and Taylor Springs.

JOLIET, ILL.—The City Council has accepted the contract of the Public Service Co. of Northern Illinois to light the streets of the city for a period of five years at the rate of $62.50 per lamp per year.

MOLINE, ILL.—The City Commissioner has called a special election

to be held on July 23 to vote on the propositions to grant franchises to the Central Union Tel. Co. and the Tri-City Automatic Home Tel. Co.

NOKOMIS, ILL.—The electric plant of the Nokomis El. Lt. & Pwr. Co. has been purchased by F. S. Peabody. It is stated that the Peabody mine will be equipped with electrically driven machinery.

OGDEN, ILL.—The Village Board has voted to enter into a contract with the Illinois Trac. Co. for lighting the streets of the village.

RANTOUL, ILL.—A committee, consisting of O. E. Williams, J. C. Webber and E. J. Molley, has been appointed to investigate the feasibility of installing a new electric-lighting system.

ROBINSON, ILL.—The property of the Robinson Wtr., Lt. & Ht. Co. was recently sold to Henry G. Starr, of Chicago, and J. P. Goodrich, of Indianapolis, Ind., for $100,000. The new owners propose to duplicate the present electric generating unit and equip the present steam-pumping plant for electrical operation.

SPRINGFIELD, ILL.—The city of Springfield is preparing to submit a bid for furnishing electricity from its plant at the municipal waterworks system to the Springfield Pleasure, Driveway and Park District, which controls several miles of boulevard lighting. W. J. Spaulding is commissioner.

STERLING, ILL.—The contractors who will dredge the Inlet swamp district near here, it is stated, may use electricity to operate machines.

KENDALLVILLE, IND.—Bids will be received by the city of Kendallville until July 10 for improvements to the municipal electric-light plant. The cost of the work is estimated at about $3,500. F. H. Froelich, Nasby Building, Toledo, Ohio, is engineer in charge; William P. Myers is city clerk.

ROLLING PRAIRIE, IND.—The County Commissioners have granted a 30-year franchise to John Wanabaugh to erect transmission lines along the streets of the village. This franchise is to permit the South Bend Electric Company to supply electricity for lighting the streets and residences here.

SOUTH BEND, IND.—The contract for the construction of the addition to the power plant of the Indiana & Michigan El. Co., on East Colfax Avenue, has been awarded to the H. G. Christman Co. The cost of the building is estimated at from $50,000 to $75,000 and that of the addition complete at about $500,000.

BURLINGTON, IA.—Plans are being considered for installing an electric-light plant in the new building of the Young Men's Christian Association.

GARWIN, IA.—The Council has granted the Tama & Toledo Electric Railway & Light Company a franchise to supply electricity for lamps and motors here. J. P. Walters, Toledo, is secretary.

LAURENS, IA.—The Town Council is considering the question of installing an electric-light system. It is proposed to secure electricity to operate the system from the Humboldt plant.

MARSHALLTOWN, IA.—Investigations are being made of the power plant of the Marshalltown Lt., Pwr. & Ry. Co., which was recently purchased by W. G. Dows and J. A. Reed, of Cedar Rapids, and others, for the purpose of securing data from which to prepare plans for extensions and enlargement to the system.

PAULLINA, IA.—Preparations are being made for extensions and improvements to the municipal electric-light and power plant and waterworks system, bids for which have been called for.

CLEARWATER, KAN.—Rollins & Westover, Kansas City, Mo., have been engaged to prepare plans and estimates for the installation of an electric-light plant here, to cost about $32,000.

CONCORDIA, KAN.—The Concordia El. Lt. Co. has applied to the Public Utilities Commission for permission to extend its transmission lines from Jamestown to Randall, Jewell City and Mankato. The company also asks permission to extend its lines to supply electricity to a large mill outside of the city.

PARSONS, KAN.—A franchise has been granted to the Union Trac. Co., Independence, for an electric railway and power plant in Parsons.

TESCOTT, KAN.—Plans are being prepared by Rollins & Westover, Kansas City, Mo., consulting engineers, for an electric-light plant in Tescott, to cost approximately $25,000.

BOWLING GREEN, KY.—The Kentucky Public Service Company contemplates the installation of a pumping station in connection with its electric-light plant.

LOUISVILLE, KY.—The Henry Vogt Machine Company contemplates building an addition to its power house and increasing the output of the plant by 300 kw.

LAKE ARTHUR, LA.—Application has been made by C. C. Ryeski for a franchise to install an electric-light system and erect transmission lines along certain streets for a period of ten years.

LAKE ARTHUR, LA.—The Lake Arthur Ice, Light & Water Works Company, Limited, has engaged H. W. Wright, supervising engineer, of Winnfield, La., to prepare plans and specifications for a complete electric-light and power plant to be operated in connection with the present ice plant.

AUGUSTA, MAINE.—The capital stock of the Northern Maine Teleg. & Tel. Co. has been increased from $10,000 to $20,000.

PRESQUE ISLE, MAINE.—The Aroostook Valley R. R. Co. will soon award contracts for the construction of a new substation at Caribou.

WATERVILLE, MAINE.—The Central Maine Pwr. Co. has acquired rights to power sites and other lands in the towns of Clinton, Canaan and Skowhegan, including a valuable water-power at the old sawmill on the Carrabasset stream at Canaan Town Hall, with mill and equipment; the Ricker mills and mill privileges on Sebasticook River in Clinton, and other property.

WATERVILLE, MAINE.—The Central Maine Power Company will begin work immediately on the erection of its 40-mile transmission line to Rockland, where it will supply electricity to operate the system of the Rockland, Thomaston & Camden Railway Company. The line will be erected from the Fort Halifax power house in Winslow to Cooper's Mills and thence to Rockland. A line will also be built from Cooper's Mills back to Augusta. The Limerick Railroad, with its 11 miles of road connecting quarries, limekilns, wharves and the Maine Central Railroad yard at Rockland, is to be equipped for electrical operation, energy for which will be supplied by the Central Maine Power Company from this transmission line. The machinery at the lime quarries, kilns and wharves will also be operated by electricity.

BOYLSTON, MASS.—At a special town meeting to be held June 24 the proposition to construct and maintain a municipal electric-light plant will be submitted to a vote.

GRANBY, MASS.—The Central Massachusetts Electric Company, Palmer, Mass., has applied to the Selectmen for permission to erect and maintain electric transmission lines in Granby.

HINSDALE, MASS.—Messrs. Sargent & Munch, who recently petitioned the town for an electric-light franchise, have decided to withdraw their application and make no further advances in the matter.

MIDDLEBOROUGH, MASS.—Arrangements are being made by George A. Philbrook, superintendent of the municipal electric-light plant, to extend the electric-light service to the residents of the Rock village.

NEW BEDFORD, MASS.—The Southern Massachusetts Power Company has filed a petition with the Board of Aldermen for permission to extend its conduits to transmit electricity into New Bedford.

SPRINGFIELD, MASS.—The Park Board is contemplating replacing the present gasoline lamps on South Grand Avenue with electric lamps.

TAUNTON, MASS.—Plans are being considered for installing a new lighting system on Main Street, City Square, Post Office Square, Church, Green, Broadway, Weir, Winthrop and Cohannet Streets.

TURNER'S FALLS, MASS.—Options have been secured on large tracts of land on Miller's River controlling valuable water sites by Fred T. Ley, who is associated with the Turner's Falls Co. It is estimated that the properties on which options have been taken are capable of developing 20,000 hp. Additions are being made to the main power plant of the Turner's Falls Co., which will increase the output from 5100 hp to 7000 hp by Oct. 1. Philip Cabot, Boston, Mass., is president of the company.

BAY CITY, MICH.—The merchants in the downtown districts have asked the City Council to submit a proposition for the installation of ornamental street lamps. It is proposed to have the city install the lamps and the merchants and property owners pay for the cost of installation.

DECATUR, MICH.—Plans are being considered for improving the municipal electric-light system. The question of purchasing electricity to operate the system rather than to rebuild the municipal plant is under consideration. A committee has been appointed by the Commercial Club to investigate the matter.

HOUGHTON, MICH.—The Granby Consol. Mining & Smelting & Pwr. Co. is contemplating improvements to its Hidden Creek property, work on which will begin immediately. The cost of the proposed work is estimated at $500,000 and will include the construction of docks, railroads to smelter site and the mines, and power house. Jay P. Graves is vice-president.

ISHPEMING, MICH.—The Marquette County Gas & El. Co. is planning to install new equipment in its power house in the near future.

WYOMING, MICH.—At an election held June 3 the citizens voted to grant a franchise to the Grand Rapids-Muskegon Power Company to supply electricity in this township. The service will now be extended into the district between this city and Grandville.

HOWARD LAKE, MINN.—The Village Council has granted the Central Minnesota Lt. & Pwr. Co. a 20-year franchise to construct and operate an electric system in this village.

JACKSON, MINN.—The contract for furnishing engine, generator etc., for the municipal electric-light plant has been awarded to J. C. Robertson, St. Paul, for $4,550.

ST. CLOUD, MINN.—A. G. Whitney, president of the Public Service Company, St. Cloud, is seeking electric-light franchises in Rockville, Richmond, Cold Springs, Paynesville and Roscoe.

BILOXI, MISS.—Estimates of the cost of a municipal lighting plant, together with a distributing system with sufficient output to supply municipal and commercial needs, have been submitted by Anderson Offutt, electrical engineer, of New Orleans. The cost of a plant that will supply electricity for about 38 per cent more street lamps than now used, operate the water-works pumps, to be shortly installed, and for commercial service, is estimated at about $75,000. A plant that will furnish power for municipal purposes only will cost about $45,000. The plans provide for a power house, to be equipped with two engines, with provision for a third; electric generators and all accessories, and complete outside equipment.

GEORGETOWN, MISS.—The Town Board has granted Wilson Hemingway, Jr., a franchise for the installation of an electric-light plant and water-works system.

POPLARVILLE, MISS.—The citizens have voted to lease the municipal electric-light and water plant for one year, with a five-year option, to J. G. Rouse. Under the terms of the contract Mr. Rouse is to pay the town $2,000 per year and to furnish street lamps free of charge.

LAMAR, MO.—Sealed bids will be received at the office of the Utilities Board of the city of Lamar until June 25 for improvements to the electric-light and water systems as follows: (1) Extensions to street mains, constructing foundations and installing machinery, connections, etc.; (2) construction new power house complete; (3) settling basin; (4) repairing old dam; (5) furnishing and installing oil engine; (6) generator, exciter and switchboard; (7) pumps and motors; (8) pole line material. Plans and specifications are on file at the above office and at the office of Rollins & Westover, consulting engineers, Rialto Building, Kansas City, Mo.

MEXICO, MO.—The committee appointed to investigate the feasibility of installing an ornamental street-lighting system reports that 44 lamp standards would be required for the area contemplated. The cost of the standards for three-lamp clusters is estimated at $2,400 and the cost of maintenance at about $350 more per year than the arc lamps now in use. The business men and property owners propose to pay for the installation. The city will be asked to bear the additional cost of maintenance.

ST. LOUIS, MO.—The National Enameling & Stamping Company is considering the installation of an electric light and power plant equipment in its new freight warehouse.

ST. LOUIS, MO.—The Barry-Wehmiller Machinery Company has purchased a site for its proposed plant, to cost about $50,000. The machinery will be equipped for electrical operation. Plans are being prepared by Widmann & Walsh, St. Louis.

STEWARTSVILLE, MO.—J. B. Keesaman, Mayville, has applied for a franchise to install and operate an electric-light system here.

WARRENSBURG, MO.—Plans are being prepared by Worley & Black, consulting engineers, Kansas City, Mo., for an electric-light plant for the State Normal School, to cost about $10,000.

LIBBY, MONT.—Plans are being prepared for the installation of an ornamental street-lighting system in the business district. It is proposed to erect steel standards carrying five-lamp clusters. The City Council has authorized the city attorney to notify the Libby Water Works, Electric Light & Power Company that its franchise has been forfeited. Other parties are seeking a franchise.

OMAHA, NEB.—Plans are being considered for the installation of a new street-lighting system in the business district. The installation of flaming-arc lamps is under consideration.

WINNEMUCCA, NEV.—The Utah-Nevada & Idaho Tel. Co. has begun work on the erection of a telephone line from Cane Springs to Southern Idaho. When completed this line will connect Oregon and Idaho towns with Winnemucca.

MIDLAND PARK, N. J.—The Borough Council has instructed the clerk to advertise for bids for the installation of 100 electric street lamps. Bids will be opened on June 25.

MILLVILLE, N. J.—The Council has decided to engage an engineer to supervise the construction of a municipal electric-light plant.

ALBUQUERQUE, N. M.—The contract for installing conduits for the new street-lighting system on Central Avenue has been awarded to the Nash Electrical Supply Company, of this city. Ornamental standards carrying three tungsten-lamp clusters will be erected.

ARTESIA, N. M.—John C. Keys, of Oklahoma City, Okla., who recently purchased a controlling interest in the Artesia Lt. & Pwr. Co., is preparing to make extensive improvements to the plant. Additional equipment will be installed in the power plant and transmission lines extended to farms in this locality. Besides furnishing electricity for operating the irrigating pumping plants the company proposes to drive wells and install pumps, for farmers who are not able to bear that expense. About $250,000 will be expended for improvements during the next 12 months.

ADAMS, N. Y.—The Adams El. Lt. Co. has applied to the Public Service Commission for approval of franchises, permission to begin construction work and authority to issue $30,000 in bonds, the proceeds to be used for improvements, and to issue $18,000 of its capital stock for the purchase of the property and assets of the Adams El. Lt. Co., Ltd.

BAYSHORE, N. Y.—A petition has been presented to the Town Board requesting it to organize a second lighting district.

BREESPORT, N. Y.—The Elmira Wtr., Lt. & R. R. Co., it is reported, is contemplating extending its transmission line from Horseheads to Breesport for the purpose of supplying electricity for lamps and motors.

BUFFALO, N. Y.—Contracts will soon be awarded by the Buffalo & Lake Erie Trac. Co. for the construction of two substations and 30 miles of 60,000-volt transmission line. The company has purchased three 500-volt rotary converters, switchboard equipment, etc.

COLD SPRING, N. Y.—The Glenham Embroidering Company, Fishkill, is establishing a branch factory in Cold Springs. The McKeel Building has been leased by the company. About 50 sewing machines will be installed, which will be equipped for electric-motor drive. Later branches will be established in Newburgh and Wappinger Falls.

FAR ROCKAWAY, N. Y.—The Public Service Commission has granted the application of the Ocean El. Ry. Co. for permission to extend its railway in Belle Harbor.

GENEVA, N. Y.—A committee has been appointed to make investigations with a view of installing a conduit system to place all wires underground throughout the city.

MOUNT VERNON, N. Y.—The Westchester Street Ry. Co. has been granted permission by the Public Service Commission to issue a first mortgage on its property to secure an issue of $2,000,000 in bonds.

NEW YORK, N. Y.—The Public Service Commission, First District, has approved the assignment for the construction of Section 13 of the Broadway-Lexington Avenue subway by the Bradley Contracting Company to McMullen, Snare & Triest, Inc. This section lies in Lexington Avenue, between 118th Street and 129th Street.

NEW YORK, N. Y.—Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 24 for furnishing and installing lighting fixtures in the new United States post office in New York, in accordance with drawings and specifications, copies of which may be obtained at the above office. James Knox Taylor is supervising architect.

NIAGARA FALLS, N. Y.—The Public Service Commission has authorized the Niagara Falls Pwr. Co. to issue bonds or capital stock to the amount of $3,567,000 to complete construction work.

OTISVILLE, N. Y.—Bids will be received by the Board of Health, corner of Centre and Walker Streets, New York, until June 25 for furnishing electrical supplies and materials as required to the Tuberculosis Sanatorium at Otisville, N. Y. Ernst J. Lederle, Ph.D., is president of board.

PERRY, N. Y.—The plant of the Perry El. Lt. Co. was destroyed by fire on June 4, causing a loss of about $50,000. It is said that the plant will be rebuilt at once.

ROCHESTER, N. Y.—Arrangements are being made by the Board of Contract for advertising for a new city lighting contract for a term of five years, bids for which will soon be called for.

HENDERSON, N. C.—A large addition is to be erected at the Harriet Mills. It will be 100 ft. by 136 ft. and will accommodate 10,000 spindles. The machinery will be equipped for electric-motor drive. Electricity will be obtained from the Southern Pwr. Co. and from the mill company's No. 2 plant.

LUMBERTON, N. C.—The Yadkin River Power Company has secured options on sites for its proposed power station in Lumberton. The company has secured contracts to supply electricity to operate the Lumberton and Dresden Cotton Mills.

SALISBURY, N. C.—The Princeton Cotton Mill Company is planning to erect a new factory, 50 ft. x 224 ft., for the purpose of manufacturing fine damasks. The mill will be equipped for electrical operation.

WHITNEY, N. C.—The North Carolina Electric & Power Company, of New York, has accepted the proposition of French capitalists to purchase its uncompleted hydroelectric plant and rights on the Yadkin River. The purchasers propose to build a large plant for the manufacture of aluminum and will organize a company under the name of the Southern Aluminum Company with a capital stock of $8,000,000.

DICKINSON, N. D.—The proposition to issue $20,000 in bonds for the installation of an ornamental street-lighting system will be submitted to a vote at the primary election.

McVILLE, N. D.—The installation of an electric-light plant in McVille is under consideration.

UNDERWOOD, N. D.—J. E. Miller, village clerk, writes that the village has not voted to issue $8,000 in bonds for the installation of an electric-light plant as reported in the issue of June 1.

AMHERST, OHIO.—J. G. Milligan, representing the Citizens' Gas & Electric Company, Lorain, has submitted a proposition to the City Council offering to take over the municipal electric-light plant and to supply the village with electricity from the central power plant which will supply Lorain and Elyria. A 24-hour service is promised. The Council has decided to abandon the municipal plant and will grant Mr. Milligan a franchise here.

CINCINNATI, OHIO.—The Public Utilities Commission has approved an issue of $750,000 in bonds by the Ohio Trac. Co., the proceeds to be used for improvement of power stations. The company proposes to convert two smaller stations from generating plants to substations.

CINCINNATI, OHIO.—The Ohio Trac. Co. is planning to increase the output of its East End power house in Cincinnati and convert its generating stations at Hunt Street and Cumminsville into substations. All electricity hereafter will be generated at the East End and Eighth Street power houses.

CLEVELAND, OHIO.—The Plain Dealer Publishing Company is contemplating enlarging its power plant.

CLEVELAND, OHIO.—Mayor Newton D. Baker has asked the City Sinking Fund Commission to purchase $500,000 of the electric-light bonds in order that a start may be made toward the erection of the proposed municipal electric-light plant.

CLEVELAND, OHIO.—According to a decision handed down by Judge Collister recently, the City Council must pass a new ordinance authorizing the sale of the $2,000,000 municipal light bonds. The city will now have to authorize the sale of the bonds and then wait sixty days before taking any action.

COLUMBUS, OHIO.—The City Council has instructed City Engineer Maetzel to prepare plans for a cluster-lamp lighting system for West Broad Street from Front Street to Central Avenue.

COLUMBUS, OHIO.—Bids will be received by W. E. Haswell, secretary State Board of Administration, until June 26 for furnishing motor-generator sets for the Columbus State Hospital and the Institution for the Feeble-Minded.

EAST LIVERPOOL, OHIO.—The City Council has called a special election to be held on July 16 to vote on the proposition to issue $60,000 in bonds for the installation of a municipal electric-light plant.

FREMONT, OHIO.—W. B. Schott, representing the Schott Engineering Co., of Chicago, Ill., recently bid in a valuable property along the Sandusky River, near Ballville, to satisfy a claim against the Fremont Pwr. & Lt. Co. It is stated that the company proposes to build a large dam across the river and erect a large hydroelectric plant.

MARYSVILLE, OHIO.—The Marysville Light & Water Company has engaged the Reliance Engineering Company, Cincinnati, to make improvements and changes in its plant.

ST. BERNARD, OHIO.—Bids will be received at the office of George Schroeder, auditor, St. Bernard, until July for $10,000 in bonds, the proceeds to be used for extensions and improvements to the municipal electric-light plant and water-works system.

TOLEDO, OHIO.—The Cleveland Tel. Co. is preparing to lay additional underground cable at a cost of about $18,000.

WILMINGTON, OHIO.—Bids will be received by Frank Babb, clerk, until July 9 for lighting the streets, alleys and public grounds of the village of Wilmington, according to plans and specifications on file in the office of the clerk. J. W. Lawhead is chairman of water and light committee.

YOUNGSTOWN, OHIO.—The City Council failed to pass on its third reading the ordinance authorizing an issue of $36,800 in bonds to install an electric plant in the basement of the market house to supply electricity for an ornamental lighting system.

ASTORIA, ORE.—The Elk Creek Lt. & Wtr. Co. is planning to construct and operate a light and water system at Elk Creek, near Astoria. Orrin Kellogg and Lester W. Humphreys are interested.

ENTERPRISE, ORE.—Arrangements are being made by the Enterprise Electric Company, to take over the plants at Wallowa and Lostine. The capital stock of the company will be increased from $50,000 to $300,000. The three plants will be connected at once. A transmission line will be erected from Enterprise through Lostine to Wallowa. Upon completion of the line the plant at Lostine will be discontinued. A 24-hour service will be established and electrical service will be supplied to the farmers along the line. W. C. Sivyer and L. M. Simpson, both of Spokane, Wash., are interested in the company.

PORTLAND, ORE.—The Portland, Eugene & Eastern Ry. Co. has begun work on the construction of an electric railway between Canby and Molalla, Ore., a distance of 10 miles. The railway will connect with the main line that will tap the Willamette Valley from Eugene to Portland.

PORTLAND, ORE.—The trustees of Reed College are asking for bids for the erection of a light and power plant and for installation of machinery, the entire plant to cost about $40,000. The plant will also provide for heating the buildings as well as lighting. Doyle, Patterson & Beach are architects.

ROSEBURG, ORE.—The Roseburg light and power plant has been purchased by A. Welch & Co., who are in control of the Oregon El. Ry. It is understood that the railway will be extended into Roseburg.

ERIE, PA.—Work will soon begin on the construction of the power plant of the Erie Lighting Company to be erected on Peach Street. The building will be of brick construction, 42 ft. by 81 ft., to cost about $235,000. The Henry Shenk Company has the general contract.

GLASSPORT, PA.—The Monongahela El. Lt. Co. has extended its transmission lines to this borough and has submitted a proposition to the Council for street lighting.

GREENVILLE, PA.—The Mercer County Lt., Ht. & Pwr. Co., which is erecting a transmission line into Mercer, a distance of 15 miles, is making extensive additions to its plant in Greenville. Two 90-kw alternating-current generators, direct-connected, are being installed. The company will supply electricity to residents along the line.

JOHNSTOWN, PA.—The South Fork-Portage Ry. Co. is contemplating the construction of a temporary substation, to be equipped with one 300-kw rotary converter with transformers.

JOHNSTOWN, PA.—The directors of the Johnstown Tel. Co. have authorized an issue of $100,000 in capital stock. In addition to the work being done in the Blacklick region and at Dunlo and Beaverdale, the company plans to provide service to Park Hill, Mineral Point, Echo and Vinco.

KITTANNING, PA.—The Kittanning & Leechburg Rys. Co. contemplates building an addition to its power house in Garret's Run, plans for which have been prepared.

KITTANNING, PA.—It is reported that the Clarion Wtr. Pwr. Co., the Butler Wtr. Pwr. Co. and the Kittanning Wtr. Pwr. Co. are interested in a large water-power project which will involve an expenditure of about $150,000,000. It is proposed to utilize several natural reservoirs in the tributaries of the Allegheny River to generate electricity for light, heat, power and street-railway purposes throughout Western Pennsylvania. Kuhn, Loeb & Co., New York, and W. S. Kuhn & Co., Pittsburgh, it is said, are financing the undertaking.

LANCASTER, PA.—The Christiana Suburban Electric Company has increased its capital stock from $35,000 to $70,000. A number of companies have consolidated with the company and will operate in the eastern part of Lancaster County.

PHILADELPHIA, PA.—The electrical committee of the City Council has authorized locations for the erection of 200 new electric lamps throughout the city.

WILKES-BARRE, PA.—The Park Commissioners have granted the contract for lighting the Public Square to the Wilkes-Barre Company.

PROVIDENCE, R. I.—The Rhode Island Power Transmission Company has applied to the City Council for a franchise to erect and maintain transmission lines for the distribution of electricity for lamps, heat and motors in Providence.

WESTERLY, R. I.—Bodell & Co., of Providence, R. I., have acquired the controlling interest in the Westerly Lt. & Pwr. Co. The company furnishes electricity in Westerly, Watch Hill, Ashaway and Pleasant View, R. I., and Pawcatuck, Stonington, Mystic and part of Groton, Conn. The new owners, it is said, propose to develop and extend the system.

CAMDEN, S. C.—At an election held June 12 the proposition to issue $100,000 in bonds for the installation of an electric-light plant and water-works system was carried.

SPARTANBURG, S. C.—Preliminary arrangements are being made by the Spartanburg & Glenn Springs R. R. Co. for the construction of an electric railway from Spartanburg to Glenn Springs, a distance of about 14 miles. J. B. Lee and J. T. Harris are interested in the project.

GARRETSON, S. D.—At an election held recently the proposition to issue bonds for the construction of a municipal electric-light plant was carried.

VOLGA, S. D.—The City Council has granted a franchise for the installation of an electric-light system here.

ATHENS, TENN.—Bonds to the amount of $38,000 have been voted for the installation of a 500-hp electric plant, extensions to water and sewer mains.

CHATTANOOGA, TENN.—The Chattanooga Ry. & Lt. Co. is planning to build an extension from Chamberlain Street to Vance Avenue; also an extension from Mission Ridge to Lookout Mountain.

GREENEVILLE, TENN.—Plans are being considered for the construction of a power dam on the Chucky River, 6 miles from Greeneville, for the purpose of supplying electricity in Greeneville, Morristown, Newport, Jonesboro, Erwin, Johnson City and intervening towns. The company, it is understood, contemplates the purchase of the local electric-light plant. Dr. C. P. Fox is interested.

SWEETWATER, TENN.—The local electric-light plant has been purchased by the Ocoee Pwr. Co.

AUSTIN, TEX.—The City Commission is considering plans for the installation of an ornamental street-lighting system on North Congress Avenue.

AUSTIN, TEX.—The Austin Street Ry. Co. is planning to build an extension of its railway to the site of the dam that is being built across the Colorado River, a distance of about 2 miles.

DEL RIO, TEX.—Plans are under consideration by Dr. F. S. Pearson, of New York, and associates for the construction of a large dam across the Devil's River, about 50 miles north of here, for the purpose of forming a storage reservoir to supply water to irrigate a large tract of land and to provide power for a hydroelectric plant.

GALVESTON, TEX.—The County Commissioners are considering several plans for lighting the causeway.

NEW BRAUNFELS, TEX.—The contract for improvements to the water-works system and electric-light plant has been awarded to the Midland Engineering & Construction Co., Fort Scott, for $58,000. The W. K. Palmer Co., Kansas City, Mo., has charge of the engineering work.

RIO GRANDE, TEX.—The installation of electric-light and ice plants here is under consideration by J. Thaison, of Rio Grande.

SANDERSON, TEX.—Preparations are being made by E. McGinley for the installation of an electric-light plant and ice factory here.

WACO, TEX.—The Texas Light & Power Company has purchased a site on the Brazos River, near Waco, on which it will erect a large power plant.

WAXAHACHIE, TEX.—One of the first improvements to be made by Benjamin C. Hyde and associates, of Kansas City, Mo., who recently purchased the property of the Ellis County Independent Tel. Co., will be the erection of a long-distance telephone line between Waxahachie and Dallas.

LYNCHBURG, VA.—The Virginia State Epileptic Colony is asking for bids for one 150-hp water-tube boiler and an 80-hp engine direct-connected to 35-kw, 40-kw and 50-kw alternating-current generators. D. S. Priddy, Madison Heights, Lynchburg, Va., is superintendent.

BELLINGHAM, WASH.—The Whatcom County Railway & Light Company has applied for a franchise to erect a new transmission line from Sumas to Bellingham and through the city to the York Street station. This line will connect with the transmission line of the Western Canada

Power Company at Sumas and will supply electricity to the Olympic Portland Company's plant and to the Bellingham-Skagit interurban railroad and for lamps, etc.

CHESAW, WASH.—The Farmers' Tel. Co. has leased the telephone system of the Chesaw-Myncaster Tel. Co. for a period of 10 years. Extensive additions will be made to the system of the Farmers' Tel. Co.

ELLENSBURG, WASH.—The City Council has granted the petition of W. C. Wright and others to connect with the municipal electric transmission line so as to secure electricity for lamps and motors on their ranches. The municipal light department will erect the line to the city limits and the ranchers will pay for the system from the city limits to the consumers. Motors will be installed on several of the ranches for irrigation purposes. It is expected that several transmission lines radiating to all parts of the valley will be erected during the coming year.

LATAH, WASH.—The installation of an electric-light plant and waterworks system here is under consideration.

RICHLAND, WASH.—The plant of the Pacific Pwr. & Lt. Co. at Richmond was recently damaged by fire, causing a loss of about $10,000.

SULTAN, WASH.—J. S. Burton, of Snohomish, has been engaged as construction engineer for an electric-light and power system, including water-power development, in Sultan. Frank Freise and Herman Freise, of Snohomish, and I. C. Anderson are interested in the project.

EAGLE, W. VA.—The St. Clair Colliery Company is reported in the market for a 150-kw. to 200-kw. 250-volt direct-current generator with pulley and switchboard.

GRAND RAPIDS, WIS.—Preparations are being made by the Consol. Wtr. Pwr. & Paper Co. to raise the dam at Biron 6 ft.

MILWAUKEE, WIS.—The Council committee on sewerage has recommended a resolution appropriating $4,000 to purchase electricity from the Milwaukee Railway & Light Company to operate the Milwaukee River dumping station.

MOUNT HOREB, WIS.—A petition is being circulated by Harry Harper, manager of the local electric-light plant, with a view of having the village consider the purchase of his plant.

OAKFIELD, WIS.—The contract for construction of power house for the Oakfield Pwr. & Lt. Co. has been awarded to the Hunter Constr. Co. The Central Constr. Co., of Oshkosh, has secured the contract for furnishing generators, battery and pole-line equipment.

PRESCOTT, WIS.—The Clifton Light & Power Company has been reorganized under the name of the River Falls Power Company. Work will begin on construction of the dam at Clifton and the plant will be in operation in about two months. B. W. Utman is president.

PRESCOTT, WIS.—A proposition to purchase the local electric-light system is under consideration. The Clifton Lt. & Pwr. Co. has offered to sell its plant to the city for $10,000 and to furnish energy to operate the system at the rate of 4 cents per kilowatt for the first 5000 kw each month and 2 cents for all above that amount.

CHEYENNE, WYO.—The Northern Colorado Power Company is negotiating with the Union Pacific Railroad Company for equipping its machine and repair shops and roundhouse in Cheyenne, Wyo., for electrical operation.

NELSON, B. C., CAN.—The West Kootenay Pwr. & Lt. Co. has decided to install an 8000-hp generating unit at its No. 2 plant at Bonnington Falls, increasing the output to 21,200 hp. The company is preparing to furnish electricity for the Canadian Pacific Railway, which is to be equipped for electrical operation from Castlegar to Rossland. The overhead system will be used.

VICTORIA, B. C., CAN.—The British Columbia El. Ry. Co. has awarded the contract for the construction of an auxiliary power plant on Saanich Inlet to C. C. Moore & Co., San Francisco. The cost of the plant is estimated at $400,000.

COLDWATER, ONT., CAN.—The ratepayers have voted in favor of the hydroelectric by-law.

PORT ARTHUR, ONT., CAN.—Plans are being considered for the construction of an electric belt railway, 7 miles long, to connect with the main line and the Arthur Street extension in Port Arthur.

RIDGETOWN, ONT., CAN.—The ratepayers have voted in favor of the purchase of the local electric-light plant at $10,500.

HUMBOLDT, SASK., CAN.—The Town Council has decided to begin work on the construction of an electric-light plant and water-works system.

SASKATOON, SASK., CAN.—The ratepayers have voted in favor of the by-law to expend $175,000 for machinery for the municipal electric-light and power plant and $80,000 for extension to distributing system.

SASKATOON, SASK., CAN.—A charter has been granted to the Canadian Agency, London, Eng., for constructing a dam on the river about 13 miles north of Saskatoon, on which preliminary work has begun. The Canadian Agency will spend about $2,200,000 during 1912 on the dam and laying about 9 miles of street railway.

TAMPICO, TAMAULIPAS, MEX.—The Mexican Midland Lt. & Pwr. Co. has been incorporated under the laws of the Province of Ontario, Canada, to work the concessions granted the Compañia Hydro-Electrica Mexicana, S.A. These concessions authorize the development of the waterfalls of the Naranjo River and the Blanco River for the purpose of generating electricity. It is estimated that 65,000 hp can be developed from the Naranjo River during the year and 35,000 hp from the Blanco River. It is said that the capacity of both plants can be doubled at a comparatively small cost. Electricity generated at the plants will be transmitted to Tampico, San Luis Potosi and Monterey.

New Industrial Companies

THE ANDERSON THRALL COMPANY, of Chicago, Ill., has been incorporated by George W. Brown, E. H. Bjornberg and Alfred H. Pouse. The company is capitalized at $7,500 and proposes to deal in electrical supplies of all kinds, including electric batteries and machinery.

THE J. J. DUCK COMPANY, of Toledo, Ohio, has been incorporated with a capital stock of $50,000 by John J. Duck, William B. Duck, C. A. McNeil, H. M. Hart and F. E. Leonard. The company proposes to do an electrical construction and supply business.

THE ECONOMY CAR HEATING & EQUIPMENT COMPANY, of New York, N. Y., has been incorporated with a capital stock of $150,000 for the purpose of manufacturing car-heating and railway appliances. The incorporators are: R. Catlin, I. C. Ramsburg and F. L. Durk, Brooklyn, N. Y.

THE JONES ELECTRIC STARTER COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $10,000 to manufacture automobile starters. The incorporators are: Charles H. and Gustav A. Roth and Edward L. Jones.

THE KEITH LIGHT COMPANY, of New York, N. Y., has filed articles of incorporation under the laws of the State of Delaware. The company is capitalized at $600,000 and proposes to deal in all inventions pertaining to gas and electricity.

THE KING BURGLAR ALARM COMPANY, of New York, N. Y., has been incorporated by Fred T. King, Brooklyn, N. Y.; Fred B. Holden and Alfred Houston, New York, N. Y. The company is capitalized at $60,000 and proposes to install electrical alarm devices.

THE PUBLIC UTILITIES CONSTRUCTION COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $30,000. The incorporators are: M. A. Fuller, Germantown, Pa.; Henry B. McCarty and William E. Scott, Philadelphia, Pa.

THE ROGERS ELECTRIC LABORATORIES COMPANY, of Augusta, Maine, has been organized under the laws of the State of Maine with a capital stock of $100,000 for the purpose of manufacturing and selling electric motors, dynamos and electrical machinery. E. M. Leavitt, Winthrop, is president and treasurer.

THE THOBAL ELECTRIC COMPANY, of St. Louis, Mo., has been incorporated with a capital stock of $50,000 for the purpose of manufacturing and dealing in electrical and mechanical machinery. The incorporators are: Daniel Tibbals, Emilie Thomas and Lewis Knapp.

THE UNITED ELECTRIC SEWING MACHINE COMPANY, of Brooklyn, N. Y., has been incorporated with a capital stock of $2,100 by Hyman Youndelman, Mark Lang and Nathan Cohen, of Brooklyn, N. Y.

THE VOLT AMPERE COMPANY, of San Antonio, Tex., has been organized by W. G. E. Rolaff, J. O. Luthy and Yale Hicks. The company is capitalized at $10,000 and proposes to establish a plant to manufacture electrical appliances, batteries, etc.

New Incorporations

WILMINGTON, DEL.—Articles of incorporation have been filed for the American Ry. & Pwr. Co. under the laws of the State of Delaware by R. B. Cooling, C. J. Jacobs and H. W. Davis, of Wilmington. The company is capitalized at $2,500,000.

DUGGER, IND.—The Dugger El. Lt. & Pwr. Co. has been incorporated with a capital stock of $12,000 by W. D. Hodson, W. T. McCaskey and S. F. Seager, all of Lansing, Mich.

INDIANAPOLIS, IND.—The Public Utilities Company of Evansville has filed articles of incorporation. The company is capitalized at $6,000,000 and has taken over the gas, steam-heat and electric plants and the street railway in Evansville. The incorporators are: John G. McKee, Lafayette; Walter J. McGraw, Lafayette, and William Winter, of Indianapolis.

INDIANAPOLIS, IND.—The Vermilion Trac. Co. has been granted a charter with a capital stock of $25,000, which, it is stated, will be increased to $600,000 in the near future. The company proposes to build an electric railway to extend from Terre Haute through Clinton, Hillsdale, Dana, Newport, Cayuga and Perrysville, thence across the Indiana line into Illinois and to the present terminus of the McKinley lines at Ridge Farm, Ill. The main office will be in Indianapolis.

REXVILLE, IND.—The Farmers' Mutual Tel. Co. has been incorporated with a capital stock of $5,000 by G. H. Delay, J. H. Craig and M. Jackson.

RICHMOND, IND.—The Southwestern Utilities Corporation has been incorporated with a capital stock of $15,000,000 for the purpose of owning public utilities such as water-works, gas plants, electric plants, etc.

The officers are: Thomas B. Day, president; H. H. Chalkley, secretary, and L. B. Duer, treasurer.

AUGUSTA, MAINE.—The Dominion Gas Co. has filed articles of incorporation with a capital stock of $3,000,000 for the purpose of owning and operating gas and electric generating plants. I. S. Kearney, Augusta, is president and treasurer.

OSCEOLA, MO.—The Osceola Lt. & Wtr. Co. has been chartered with a capital stock of $25,000 by C. R. Hunt, A. M. Seddon and A. W. Burton.

LINCOLN, NEB.—The Commonwealth Devel. Co. has been incorporated by W. E. Sharp, A. W. Field, C. T. Boggs, S. H. Burnam, of Lincoln; A. C. Koenig, of Omaha; J. M. Bramlette, Detroit, Mich., and A. A. Ladd, Lansing, Mich. The company is capitalized at $7,500,000 and proposes to carry out a large hydroelectric project on the Loup River between Columbus, Lincoln and Omaha.

MACEDON, N. Y.—The Macedon Pwr. Co. has been granted a charter with a capital stock of $15,000 for the purpose of supplying electricity in the towns of Macedon, Walworth and Farmington. The directors are: Edwin Youngs, Minnie A. Youngs and George L. Colgate, of Rochester.

FAYETTE, N. C.—The Fayette Lt. & Pwr. Co. has been incorporated with a capital stock of $150,000 by W. W. Randolph, New York; John Rurlin and Thomas Badger, both of Fayetteville. The company will take over the property and holdings of the Fayetteville Gas & El. Co. and the street railway system of Fayetteville.

TOLEDO, OHIO.—The Independent El. & Constr. Co. has been incorporated with a capital stock of $10,000 for the purpose of supplying electricity and doing electric construction work in Lucas and Wood Counties. The company will build an electric-power plant in Maumee and furnish electricity in Maumee and Perrysburg first.

BETHEL, PA.—The Bethel El. Co. has been incorporated to operate an electric system in Bethel Township. The company is capitalized at $5,000 and the incorporators are: Walter P. Rainbow, Leetsdale; Charles A. Lampe, Glen Osborne, and W. W. Murray, Bridgevil'e. The office of the company is located in Mount Oliver.

CARRICK, PA.—The Carrick El. Co. has been incorporated by Donald Thompson, Edgeworth; C. B. Pritchard and M. V. Copeland, Pittsburgh. The company is capitalized at $5,000 and proposes to operate an electric system in Carrick.

HARRISBURG, PA.—Charters have been granted by the State Department to 30 light, heat and power companies in Cambria County, as follows: Adams, Bluffington, Blacklick, Banks, Burrell, Brush Valley, Barr, Carroll, Cherry Hill, Cambria, Centre, Conemaugh, East Wheatfield, East Lortay, Green, Jackson, Lower Yoder, Montgomery, Phine Jose, Pine, Portage, Rayne, Richland, Susquehanna, Summer Hill, Stony Creek, Upper Yoder, White, West Wheatfield and West Taylor Townships. Each company is capitalized at $5,000, and the incorporators are: P. J. Morrisey, Augustus Weis and J. W. Blough, all of Johnstown. J. W. Blough is treasurer of all the companies. It is understood that these companies will be merged into one company.

KNOXVILLE, PA.—The Knoxville Lt. Co. has been granted a charter with a capital stock of $5,000 to operate in Knoxville. The incorporators are: J. F. Grimes, J. P. Moore, of Knoxville, and J. P. Caufield, Verona.

MOUNT OLIVER, PA.—The Concord El. Co. has been incorporated with a capital stock of $5,000 to operate in Lower St. Clair. The incorporators are: C. B. Mehard and Joseph A. Jenkins, Pittsburgh, and E. N. Barber, Crafton.

MOUNT OLIVER, PA.—The Mount Oliver El. Co. has been chartered with a capital stock of $5,000 to operate in Mount Oliver. The incorporators are: Donald Thompson, Edgeworth; C. B. Pritchard and M. V. Copeland, Pittsburgh.

NEW KINGSTON, PA.—The New Kingston El. Lt., Ht. & Pwr. Co. has been granted a charter with a capital stock of $5,000 for the purpose of supplying electricity in New Kingston. The incorporators are: Charles and John Hetrick, J. L. V. Smith, C. H. Bear, W. H. Ray and Frank Bricker.

SCOTT, PA.—The Scott El. Co. has been granted a charter to operate an electric system in Scott Township. The company is capitalized at $5,000, and the incorporators are: Walter P. Rainbow, Leetsdale; Charles A. Lampe, Glen Osborne, and W. W. Murray, Bridgeville. The office of the company is located in Mount Oliver.

JOHNSON CITY, TENN.—The Tennessee Eastern El. Co. has been incorporated under the laws of the State of Massachusetts with a capital stock of $1,650,000. The company proposes to generate and distribute electricity in Johnson City. The main office of the company will be located in Boston, Mass. The incorporators are: Merrill Griswold, Robert J. Richardson and Thomas Sweeney.

DALLAS, TEX.—The Texas Pwr. & Lt. Co. has been granted a charter to acquire and operate electric light and power and gas properties in Texas. The company is capitalized at $13,000,000 and will immediately take over the properties, franchises and rights of the Waco El. & Gas Co., Waco; the Cleburne El. & Gas Co., Cleburne; the Hillsboro El. & Gas Co., Hillsboro; the Waxahachie El. & Gas Co., the Temple El. Lt. Co., Temple; the Sherman El. & Gas Co., Sherman, and the Bonham El. & Gas Co. The company has a contract for a period of 50 years with the Southern Trac. Co. to supply electricity for its Waco traction system and for its interurban lines, which are to be built from Waco to Dallas and from Dallas to Corsicana. The system now planned will cover about 135 miles of interurban lines in addition to the present Waco city system, which consists of about 16 miles of track.

POST, TEX.—The Post Pwr. Co. has been incorporated with a capital stock of $100,000 by Charles W. Post, Arthur B. Williams, Louis E. Hick, of Battle Creek, Mich., and H. W. Fairbanks, of Post. The company proposes to install and operate an electric light and power plant here.

RICHMOND, VA.—A charter has been granted to the Illuminating & Pwr. Co. Securities Corpn., with a capital stock of $8,000,000, which will act as the holding corporation for various light and power manufacturing enterprises throughout the State of Virginia. H. G. Buchanan, of Richmond, is president of the company and R. Ripley Dana, Newton, Mass., is secretary.

RICHMOND, VA.—The Central States El. Co. has been incorporated under the laws of the State of Virginia. The company is capitalized at $40,000,000 and proposes to operate electric power and lighting plants. The charter stipulates that it is to acquire not less than 60 per cent of the capital stock of the Cleveland El. Illg. Co., Cleveland, Ohio. The officers of the company are: Earle G. Hines, Albany, N. Y., president; Leon Kojassar, Whitestone, treasurer, and Alfred Gregory, Brooklyn, N. Y., secretary.

Trade Publications

ELECTRICITY IN THE SHOE AND LEATHER INDUSTRY.—The extent to which electric drive is being applied to the shoe and leather industry, and the advantages to be derived from this application, are shown in Bulletin No. 4931 issued by the General Electric Company. The bulletin contains illustrations and descriptions of various installations of this nature.

STEAM METERS.—The Steam Appliance Company, 304 West Randolph Street, Chicago, Ill., illustrates and describes the Gebhardt Steam Meter in its recent catalog. Good-sized type, clear and ample illustrations and a miniature velocity chart to save time in calculating velocities, discharge and size of pipe required for given conditions of flow make this a very practical publication.

ELECTRICAL FITTINGS.—A recent catalog of the Fancleve Specialty Company, of 284 South Street, Jamaica Plain, Mass., contains descriptions, fully illustrated, of the complete line of the company's fittings and an alphabetical and numerical index to facilitate locating any fitting in the catalog. Its line contains seven hundred varieties which have been worked up in six years' time.

INCANDESCENT LAMPS FOR RAILWAY SERVICE.—Bulletin 4947 of the General Electric Company is devoted to the illumination of electric railway cars and the advantages possessed by drawn-wire tungsten and graphitized-filament lamps for this service. The bulletin contains illustrations showing the illumination of cars by these two types of lamps as compared with that resulting from the use of the old carbon-filament lamp.

INDICATORS.—"A description of the latest types of engine indicators and accessories, with information on the taking and reading of indicator cards," gives, as a sub-title, a comprehensive idea of the contents of "The Indicator Book," issued by the Trill Indicator Company, Corry, Pa. Aside from its exploitation of the Trill indicator, the book gives a large amount of general information said to be new and original on its subject matter which will interest engineers.

ROLLER BEARINGS.—An ingenious device giving at a glance decimal equivalents is being sent out by the Standard Roller Bearing Company, Philadelphia, Pa. It consists of a wheel of celluloid, with saw edges, inclosed within two pieces of celluloid 3 in. by 3 in., a ½-in. semicircular opening on the four sides allowing for the easy turning of the wheel. Two perforations about 0.75 in. from the center allow space for the figures in combination, producing certain results which are instantly visible. On each of the four corners on both sides of the cover the names of the company's products add advertising value to this device.

Business Notes

BUSCH-SULZER BROTHERS-DIESEL ENGINE COMPANY.—Mr. George F. Murphy has been appointed Eastern sales representative of the Busch-Sulzer Brothers-Diesel Engine Company, replacing Mr. W. R. Haynie. The Eastern sales office of the company will be at 30 Church Street, New York, as heretofore.

WESTERN ELECTRIC COMPANY.—A large warehouse and branch office to handle more effectively the growing business on the Gulf Coast has been opened by the Western Electric Company at Houston, Tex. The new office will be operated as a branch of the Dallas organization under the supervision of Messrs. R. W. Van Valkenburgh and Paul Joyslin, manager and sales manager respectively. The local organization will have as its resident heads Mr. H. P. Hess, in charge of sales; Mrs. F. G. Caldwell, in charge of store, and Mr. M. A. Schon, in charge of warehousing. Complete stocks of telephone, power, supply and line material will be carried.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 11, 1912.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,028,853. SIGNAL MECHANISM FOR ELECTRIC RAILWAYS; R. D. Beatty, Cleveland, Ohio. App. filed March 15, 1911. Crossing and block signal for trolley lines.

1,028,854. VEHICLE SIGNAL; E. J. Best and C. M. Fitch, Chicago, Ill. App. filed Dec. 27, 1910. Rear sign light for automobiles, etc.

1,028,856. ANNUNCIATOR AND CABINET FOR BARBER SHOPS; I. J. Bradshaw, Waukegan, Ill. App. filed July 1, 1911. Electromagnetically driven chain and indicator.

1,028,857. APPARATUS FOR PREPARING OXONE; G. F. Brindley, San Francisco, Cal. App. filed Feb. 17, 1909. Raw materials are fed from a hopper into a pivoted melting pot.

1,028,895. ELECTROLYTIC DEPOSITION OF METALS; P. Marino, Regent's Park, London, England. App. filed Feb. 21, 1912. The salt of the metal to be deposited is dissolved in an aqueous solution of sodium glycero-borobenzoate.

1,028,910. SAFETY JEWEL CHEST; H. Schmarsow, New York, N. Y. App. filed Nov. 25, 1911. Automatic alarm attachment.

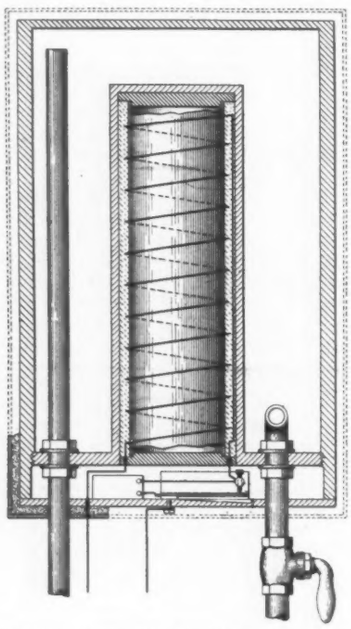
1,028,912. ELECTRIC STEAM GENERATOR; S. Schoenbroon, Pittsburgh, Pa. App. filed Jan. 4, 1912. Electric conduit with a plurality of electrodes inside a boiler.

1,028,948. CONTROLLER; J. G. Menningen, West filed Dec. 27, 1910. The movable controller members are carried by hinged parts of the casing to facilitate inspection.

1,028,957. PLUG SOCKET; J. W. Phelps, Detroit, Mich. App. filed April 9, 1909. Adapted for a drop light or pendent switch support.

1,028,963. DYNAMO-ELECTRIC MACHINE; W. H. Powell and R. B. Williamson, Milwaukee, Wis. App. filed April 8, 1910. Air-cooled turbo-generator.

1,028,964. BRUSH FOR DYNAMO-ELECTRIC MACHINES; A. Press, Norwood, Ohio. App. filed March 17, 1906. Alternate laminae of iron and insulating material



1,029,523.—Automatic Electric Water Heater.

1,028,965. DYNAMO-ELECTRIC MACHINE; H. H. Ralston, Norwood, Ohio. App. filed Jan. 27, 1905. Slotted connection between a commutator connector and a commutator segment.

1,028,969. X-RAY TUBE; J. Rosenthal, Munich, Germany. App. filed Sept. 21, 1905. Has an interior screen for absorbing the rays of lower penetration.

1,028,980. ELECTRICAL SIGNALING DEVICE; T. Weiss and T. A. Walther, Chicago, Ill. App. filed Oct. 21, 1911. Motor-driven vibrating horn.

1,028,985. DYNAMO-ELECTRIC MACHINE; B. A. Behren, Norwood, Ohio. App. filed Aug. 21, 1905. Support and retainer for the coil-end turns.

1,028,993. MOTOR-OPERATED SWITCH; H. W. Cheney, Milwaukee, Wis. App. filed April 3, 1909. Remote-control type of double-break rotary switch.

1,029,007. FREQUENCY-RESPONSIVE DEVICE; B. Frankenfeld, Los Angeles, Cal. App. filed March 12, 1910. Automatically reversible device, for instance, for controlling a supply of steam to a turbo-generator.

1,029,015. SECONDARY BATTERY; G. J. Johnson, Chicago, Ill. App. filed Aug. 28, 1911. Improvements in the plates. (See Patent No. 969,876.)

1,029,040. CONDUIT; H. H. Balliett, Pittsburgh, Pa. App. filed April 29, 1911. Multiple layer, flexible, non-metallic.

1,029,042. ELECTRICAL MEASURING INSTRUMENT; W. E. Beede, New York, N. Y. App. filed April 8, 1911. West pocket meter.

1,029,044. MECHANICAL MOVEMENT AND ELECTRIC-LIGHT SOCKET; T. A. C. Both, New York, N. Y. App. filed Dec. 30, 1911. Rotary snap switch.

1,029,098. HIGH-POTENTIAL ELECTRIC SWITCH; C. C. Badeau, Winthrop, Mass. App. filed April 6, 1911. Ventilated oil-tank switch.

1,029,114. HEATER AND GLOWER RENEWAL FOR LAMPS; O. Foell, Newark, N. J.; A. Kusebauch and R. Neckerman, Pittsburgh, Pa. App. filed Nov. 11, 1908. Removal heater.

1,029,121. APPARATUS FOR GRAPHITIZING LARGE ELECTRODES; P. L. T. Héroult, La Praz, France. App. filed Oct. 18, 1909. A furnace for containing a plurality of electrodes placed end to end.

1,029,122. GRAPHITIZING ELECTRODES; P. L. T. Héroult, La Praz, France. App. filed Feb. 10, 1910. An electrode is formed by passing a current through a plurality of sections placed end to end under pressure.

1,029,123. ELECTRICAL MEANS FOR MAGNIFYING SMALL MECHANICAL EFFECTS; E. S. Heurtley, Oxford, England. App. filed June 29, 1910. A gas is caused to flow past a heated resistance.

1,029,150. ELECTROMAGNET; N. H. Suren, Needham, Mass. App. filed July 22, 1910. Incombustible supports for the different parts.

1,029,179. AUTOMATIC FIRE-ALARM APPARATUS; G. F. Emch, Woodville, Ohio. App. filed Aug. 30, 1911. Fuse-operated device.

1,029,202. SAFETY BOLT TO LOCK AND RELEASE THE LEVERS SERVING TO OPERATE FROM A DISTANCE A SWITCH, SIGNAL, ETC., FOR RAILWAYS; C. Legrand and A. Armel, Paris, France. App. filed April 7, 1909.

1,029,207. INSULATOR SUPPORT; O. P. Megahan, Westerville, Ohio. App. filed July 18, 1911. Combination of vertical and suspended pins.

1,029,210. AUTOMATIC BRAKE-APPLYING MEANS FOR RAILWAYS; A. Minnick. Cœur d'Alene, Idaho. App. filed Aug. 20, 1909. Air-brake control; two sectional conductors alongside of the track.

1,029,230. APPARATUS FOR HEATING ELECTRICAL UNITS; H. H. Russell, New York, N. Y. App. filed April 6, 1911. Radiating heater unit removably supported in a casing.

1,029,233. ELECTRIC SADIRON; V. Schild, Brienz, Switzerland. App. filed Jan. 31, 1911. Separable casing.

1,029,275. RAILWAY SIGNALING APPARATUS; C. W. Coleman, Westfield, N. J. App. filed Feb. 15, 1909. Block semaphore system with motor and fluid-driving connection.

1,029,276. REGULATING DYNAMO-ELECTRIC MACHINES; G. H. Condict, New York, N. Y., App. filed Jan. 10, 1906. Speed control of railway motors.

1,029,281. BURGLAR ALARM; O. L. Davis, Iowa City, Ia. App. filed Feb. 21, 1912. Door-hinge connection.

1,029,344. REGULATING RESISTANCE FOR ELECTROLYTIC CONDENSERS; E. E. F. Creighton, Schenectady, N. Y. App. filed April 23, 1909. Thermostatic regulation.

1,029,350. METALLIC-FILAMENT LAMP; K. Farkas, Glen Ridge, N. J. App. filed Dec. 9, 1910. Elastic filament support.

1,029,361. HAIR-STEAMING DEVICE; T. Grosert and E. Unger, New York. App. filed Nov. 16, 1911. Heated tube.

1,029,362. CONTROL SYSTEM; J. L. Hall, Schenectady, N. Y. App. filed June 2, 1911. Remote control for dimmers, searchlights, etc.

1,029,366. ELECTRIC SWITCH; E. M. Hewlett, Schenectady, N. Y. App. filed Sept. 15, 1909. Remote-control power switch-tank type.

1,029,375. VAPOR ELECTRIC APPARATUS; O. O. Kruh, Schenectady, N. Y. App. filed Oct. 18, 1905. Mercury-arc rectifier.

1,029,383. PROCESS OF MOUNTING AND SOLDERING ELECTRICAL FILAMENTS; S. Marietti, Turin, Italy. App. filed July 2, 1908. Air-blown arc.

1,029,388. ELECTROMAGNETIC APPARATUS; J. McIntyre, Jersey City, N. J. App. filed May 29, 1906. Vibrating contact.

1,029,389. WELDING MACHINE; A. Metzger, Schenectady, N. Y. App. filed Feb. 23, 1909. For welding the seams of receptacles, etc.

1,029,408. TROLLEY; J. H. Walker, Lexington, Ky. App. filed July 7, 1910. Spring support for the trolley pole.

1,029,428. ELECTRICAL DISTRIBUTION SYSTEM; J. P. Crouch and J. Etchells, Newton Heath and Manchester, England. App. filed Dec. 9, 1909. Storage-battery-generator train lighting.

1,029,480. MOTOR SPEED REGULATOR; A. A. Tirrill, Schenectady, N. Y. App. filed Jan. 9, 1909. Alternating-current generator with make-and-break device.

1,029,499. TERMINAL CLIP; P. C. Hains, Jr., Washington, D. C. App. filed Nov. 22, 1911. Resilient sheet-metal jaws and clamp.

1,029,504. SELECTIVE TELEPHONE SYSTEM; W. F. Marten, Oakland, Cal. App. filed June 3, 1911. Semi-automatic apparatus.

1,029,523. AUTOMATIC ELECTRIC WATER HEATER; J. I. Ayer, Cambridge, Mass. App. filed Jan. 2, 1912. Thermal control for heating running water.

1,029,524. TELEPHONE-RECEIVER SHELL; J. F. Barbour, Elyria, Ohio. App. filed Sept. 27, 1909. Metal shell with bayonet-slot connection.

1,029,539. RHEOSTAT; W. H. Gaulke, Milwaukee, Wis. App. filed Aug. 8, 1911. Air-cooled box.

1,029,573. WIRELESS-CONTROLLED CURRENT DISTRIBUTER; C. Wirth, Nuremberg, Germany. App. filed Aug. 23, 1911. For controlling mechanism from a distance. (See Patent No. 930,588.)

1,029,577. TELEPHONE-EXCHANGE SYSTEM; E. E. Clement, Washington, D. C. App. filed March 3, 1905. Combined code signal system.

13,420 (reissue). ALTERNATING-CURRENT MOTOR; V. A. Fynn, St. Louis, Mo. App. filed April 8, 1912. Speed regulation. (Original patent No. 967,362, dated Aug. 16, 1910.)